

Technology Planning in the Schools of Southwestern Vermont

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Introduction

Theoretical rationale

As computers and related technologies play an increasingly important role in modern schools and the financial costs of obtaining and maintaining modern communications tools increases, the need for efficacious technology planning in schools becomes more apparent. In today's schools technology planning is a complex endeavor. As technology plans are developed and implemented, changes occur in the ways stakeholders interact with each other and changes occur in the ways people interact with ideas within schools. These new interactions caused by the introduction of new technology change the technology needed to sustain and enhance the interactions. The cycle of new technology causing new interactions, which create the need for new technology, continues as schools progress in today's technology-rich culture. The complexity of technology planning is compounded by the relatively recent emergence of technology as a tool for schools, the varying and irregular financial commitments of local, state, and federal governments, the pedagogical changes that accompany the arrival of computers in classrooms, and the quickly evolving nature of modern computer technology.

Problem Statement

There is little data describing the many factors influencing technology planning in the schools of southwestern Vermont. The questions that guide this study focus attention on several factors that influence the development and implementation of technology plans: What are the factors that influence how technology planners increase and maintain

the technology capacity of the region's schools? What are the factors that influence how learners use computers in the region's schools? What are the factors that influence how teachers in the region become competent users of computers? What are the factors that influence how technology-planning decisions are made in the region's schools?

Hypothesis

The expectation is that schools have developed a variety of approaches and organizations for developing and implementing technology plans. A further expectation is that technology planning efforts in the region focus attention on increasing technology capacity, which includes hardware and software, rather than focusing on the curricular, pedagogical, or professional development aspects of technology planning.

Review of Literature

Introduction

There is a generous literature that advises those involved with technology planning in schools. The volume of this literature arises from a number of factors including the multifarious nature of technology in schools. Upon reviewing the thousands of articles generated in an Educational Resource Information Center search for "technology," it becomes clear that many aspects of schools influence technology plans and technology plans influence many aspects of schools. This section reviews the literature focusing on the four research questions. In addition, the literature advising qualitative researchers and researchers using telecommunications to gather data, a literature that influenced the design of this study, is reviewed.

What are the factors that influence how technology planners increase and maintain the technology capacity of schools?

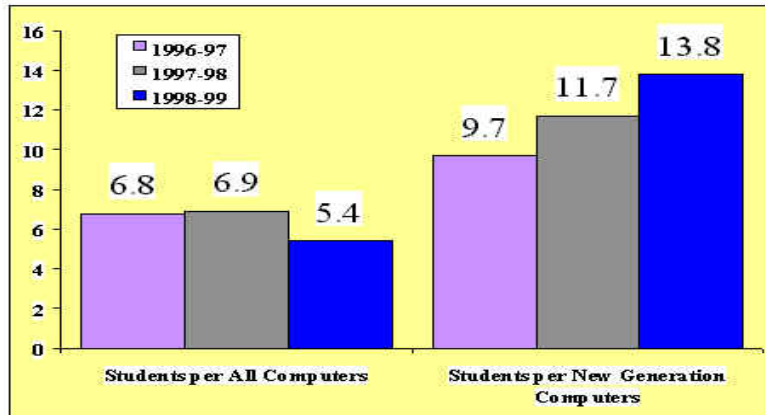
Technology capacity refers to the computer hardware, networks, and software available to students and teachers in a school, and it is perhaps the most obvious focus of technology plans. Barker and Hall (1998) summarize much of the technical inventory that constitutes technology capacity. Their list includes computer hardware, peripherals (e.g. printers and scanners), software, cable and satellite television, outside telephones, local and wide area networks, ISDN lines, Internet hosts, dial-up connections, service subscriptions, and Internet nodes.

The call to meet the Technology Literacy Challenge (United States Department of Education, 1996) has motivated stakeholders throughout the country to improve the

technology capacity of the nation's schools. This attention has led to significant improvements in the technology capacity of the nation's schools that include increased numbers of more powerful computers, and increased and faster Internet access (Market Data Retrieval, 1998; National Center for Education Statistics, 1999). Despite the improvements, Anderson and Ronnvist (1999) illustrate the still deficient technology in schools by noting that Apple II computers and IBM PS-2 model computers continue to be abundant in some schools and that much of the Internet access available in schools provides only slow connections.

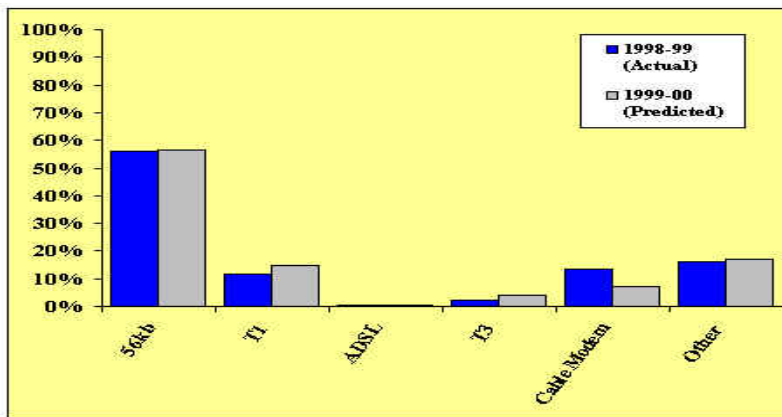
Data suggests that similar improving, but still deficient, technology capacity occurs in Vermont schools. Two sources suggest that Vermont schools have low student to computer ratios: Technology Counts'99 (1999) reports the ratio of students to instructional computers in Vermont is 5.6 and the Vermont Institute for Science, Mathematics and Technology (VISMT, 1999) reports the ratio of students to all computers in Vermont schools is 5.4. Both of these ratios are below the mean students to computer ratio in the nation, which Anderson and Ronnvist (1998) report as 6.0. Those statistics do not indicate the low capacity of these computers, however. VISMT reports the ratio of students to new generation computer is 13.8. Even before the definition of new generation computers was increased (from 386 processors to Pentium processors for PC's, and from LC-class processors to G3 processors for MacIntoshes) for the 1999 survey, the student to new generation computer ratio in Vermont schools had been increasing over the last three annual surveys of technology capacity in Vermont schools (see Figure 1).

Figure 1. The Student to computer ratios in Vermont schools (VISMT, 1999).



The deficient technology capacity of Vermont schools extends to Internet access as well. VISMT (1999) indicates that 98% of Vermont schools have Internet access. This high level of connectivity can be credited, at least in part, to the commitment of the state of Vermont to providing low cost connections which began more than three years ago (VISMT, 1996). Of the connected schools, however, only 50% have a direct link and more than half of those with direct connections have only 56kbps connections (see Figure 2).

Figure 2. Bandwidth of Vermont schools with direct Internet access (VISMT, 1999).



When defining Technology Capacity as one of the Seven Dimensions for Gauging Progress, Lemke and Coughlin (1998) identify the installed base of communications equipment, level of connectivity, available technical support among the factors contributing to the technology capacity of a school. Those authors pose the question "Are there adequate technology, networks, electronic resources, and support to meet the education system's learning goals?" to guide inquiry into and assessment of technology capacity. When making decisions related to technology capacity, technology planners can use a variety of tools to understand the technology currently available and plan for meeting future needs.

The Technology Maturity Model (TMM) (Edmin.com, 1999) includes the Hardware Inventory Surveys that can be used to gather information about the hardware, including peripherals, in each classroom of schools under study, and the Server Survey Sheet that can be used to gather data about upgrading and standardizing servers. Another tool for assessing technology capacity is the Indicators of High Performance Technology that is part of the Technology Effectiveness Framework (Jones, et al., 1995). These indicators include six variables: access, operability, organization, engagability, ease of use, and functionality. The definitions of high performance for each of these variables assist technology planners as they assess the available technology capacity and plan for improvements. The National Study of School Evaluation (NSSE, 1999) has published a similar set of indicators for assessing technology capacity in schools as part of Technology: Indicators of Quality Information Systems in K-12 Schools.

Maintaining and utilizing technology capacity requires two types of support people: technical support (installing, maintaining, troubleshooting, and repairing

hardware and networks) and educational support (teaching teachers, developing curriculum, and working with teachers on integration). Zhao et. al. (1998) suggest one of the challenges facing those who are trying to fulfill both needs is that two cultures with very different histories merge in the field of educational technology. The technical culture is often viewed by the members of the education culture as always favoring more technology and as not understanding teaching and learning, whereas the members of the educational culture is often viewed by the technical culture as being resistant to change. In order for teachers to be successful in developing technology-rich learning environments, the participation of both cultures is necessary. Through deliberate efforts to recruit individuals with backgrounds in both education and technology, Zhao and colleagues were able to facilitate collaboration between these cultures.

Middleton, Flores and Knaupp (1997) point out common frustrations that arise when new computer purchases increase the technology capacity of schools (see Table 1).

These frustrations arise from a number of sources that are permanent factors in the modern educational and technological cultures. Educators contribute to these frustrations by not being familiar with technology and

Table 1. Common frustrations that arise after computers arrive in school (from Middleton, Flores and Knaupp, 1997):

- 1) "We bought them, but nobody uses them"
- 2) "Too many kids, too few machines"
- 3) "Obsolete? We just bought them?"

by putting too much of the available resources into hardware and not enough into software and training. The technical culture contributes to the frustrations by moving too

fast. Good planning can help alleviate these frustrations, and the authors suggest plans for increasing technology capacity should ensure technology is available for collaborative learning and consider the existing resources and facilities.

Monke (1998) warns that technology plans that focus entirely on technology capacity may be characterized by a "functional rationality." This functional rationality comes from the simple, elegant solutions that can be proposed when technology capacity is the only factor under consideration. This simplicity is appealing to many, but such plans do not recognize the unique culture of the school that has so much influence on the effectiveness of the technology plan, however.

What are the factors that influence how learners use computers in the schools in the region?

The use of computers to enhance learning in schools is an aspect of educational technology that is receiving important attention from researchers and educators. Among the topics within the literature that influence the thinking about this project are efforts to define technology standards for students, to understand the perceptions of computers by students, and to understand the nature of meaningful learning in technology-rich learning environments.

Technology standards-- Becoming a skilled user of computers

Through its multi-year National Educational Technology Standards (NETS) Project, the International Society for Technology in Education (ISTE) is leading a collaborative effort to define technology standards to measure the effective development

of technology skills in today's students (ISTE, 1999). Upon completion, the NETS Project will define four sets of standards: The Technology Foundation Standards for Students (ISTE, 1999b) that describe what students should know about technology and be able to do with technology. The Standards for Using Technology In Learning and Teaching (ISTE, 1999c) that describe how technology should be used across the curriculum and in school management. The Educational Technology Support Standards that will describe the system, access, professional development, and support necessary to maintain technology-rich schools. The Standards for Student Assessment and Evaluation of Technology Use that will describe how students' progress should be measured and evaluated.

Currently, Vermont has no technology standards for students, but the state is expected to join the thirty-six states that have defined such standards after Vermont's Statewide Education Information Technology Plan is rewritten in 2000 (P. Hyjek, personal communication September 24, 1999). Although no formal process for creating technology standards for Vermont students has begun, informal discussions focusing on the vision of the Vermont technology standards have occurred. The consensus of over 30 participants at a two-hour session entitled "Technology Standards for Vermont" at VermontFest'99, the foremost educational technology conference in Vermont held in November 1999, suggest there is support for aligning the Vermont standards with the ISTE standards. Similar opinions have been expressed at several meeting of the Vermont Information Technology Association for the Advancement of Learning where the topic of standards was discussed.

Learners' perceptions of computers

The Milken Family Foundation's Exchange on Education and Technology has conducted a series of studies into educational technology from the perspective of students and parents (The Milken Exchange on Education and Technology and Peter D. Hart Research Associates, 1997 and 1998). As a part of this on-going study, focus groups were held in March 1999 in three regions around the country (The Milken Exchange on Education and Technology and Peter D. Hart Research Associates, 1999). Among the key findings of this study are the observation that today's students do not see computers as important in their academic work. This observation is made despite the technical savvy of today's youth, which is attributed to early use of computers. Data are also presented that indicate today's students recognize the attempts to create technology-rich learning environments in schools, but they do not feel the efforts are succeeding. One final important observation in this study is that today's students see good teaching as being more important to their education than good computers.

The validity of the observation that students do not see technology as being an important part of their academic lives may not remain valid in the future, however. Tapscott (1999) introduces the term "Net Generation" or "N-generation" to describe today's youth. This generation is growing up in the Digital Age, and for these people, interactive communication via the Internet is anticipated to be a way of life. Tapscott offers data that show declining television viewing among children, especially in the youth of families with Internet access, and he documents the steady growth in Internet access in United States households. According to Tapscott, youth who expect interactive communications, will demand changes in the way that schools present ideas, encourage

learning, structure the day, and assess work. The Internet-using individuals who compose the N-Generation will demand learner-centered classrooms as opposed to the teacher-centered classrooms tolerated by their television-viewing parents.

The current use of computers in schools may not be providing the opportunities for the interactive communication characterizing the learning environments that Net-generation students will demand, however. Data from the 1996 National Assessment of Educational Progress (the most recent data available) that is quoted in Coley (1999) indicate that students use computers for game playing and writing papers more frequently than they use computers for learning. The same data also indicate that as students progress through their school careers, they are more likely to be exposed to computer-based instruction and that more than half of the computer use is in math classes.

The 1996 National Assessment of Educational Progress data also describe the nature of the computer experiences for seniors bound for college in the fall of 1996 (see Table 2). Although these descriptions provide little detail into the nature of the work that falls into these categories, the activities included in these brief descriptions do not indicate the higher-order thinking skills that characterize the technology-rich learning environments anticipated by Tapscott to meet the needs of the N-generation.

Table 2. Computer experiences reported by college-bound seniors, 1996.

From Coley (1999).

Word processing-	72%
Computer literacy-	51%
Use in English class-	44%
Math problems-	27%
Data processing-	26%
Computer programming-	24%
Natural Science problems-	12%
None-	9%
Social Science problems-	8%

Student achievement in technology-rich environments

The influence of technology-rich learning on student achievement has been demonstrated in recent years. In an analysis data from the 1996 National Assessment of Educational Progress, Wenglinsky (1998) found that technology-rich instruction presented by trained teachers and including activities requiring higher order thinking skills could account for a one tenth grade level increase in fourth grade math achievement and a one-third grade level increase in eighth grade math achievement. Wenglinski concludes computers are "neither cure-alls for the problems facing schools, nor mere fads that have no impact on student learning" (p. 3 Wenglinski, 1998b). In addition, Wenglinski concludes achievement in mathematics is more influenced by the way computers are used than the frequency of computer use.

Schacter (1999) provides further evidence of the influence of technology on student achievement in a review of a series large-scale studies. The research in Schacter's

review includes over 700 studies that investigated a wide range of technology activities (including integrated learning systems, simulations, networks, and design and programming technologies) in a wide range of communities. The studies document improved achievement measured with a variety of instruments including researcher-constructed tests, standardized tests and national tests. Based on this review, Schacter concludes that the use of technology contributes to improved student achievement. Schacter does indicate, however, that simple exposure to technologies is not sufficient to cause the improved achievement; the importance of using the technology in ways that encourage higher-order thinking skills is stressed.

Learning in technology-rich environments

In the early years of educational computing, one focus of study was on the process remembered as computer aided instruction (CAI). Proponents of CAI viewed computers as the ultimately patient tutor, providing feedback, instruction, and correction according to strictly defined rules (Suppes, 1966; Jerman, 1970). These methods were based in behaviorist psychology and viewed as a way to increase the efficiency of education (Cropley and Gross, 1973). Niemiec and Walberg (1987) provide evidence that CAI methods can increase performance on standardized tests.

The paradigm of the computer as tutor that is central to the CAI learning environment continues to be offered as an effective design for technology-rich learning environments by some authors (Bennett, 1996; Strot, 1998). For the most part, however, CAI has fallen out of favor in the educational community. The dissatisfaction with CAI comes from the observation that the evidence indicating improved student performance

from CAI supports only short-term improvements on limited measurements (Office of Technology Assessment, 1988). The dissatisfaction with CAI learning environments also comes from the observation that technology-rich learning environments aligned with pedagogy based on cognitive psychology provide for more meaningful and permanent achievements (Kearsley, 1998).

While the behaviorist-based CAI model of technology-rich learning environments was being developed, another group of researchers was developing a model that is aligned with cognitive psychology. Seymour Papert was, and continues to be, a leader in this field. Papert claims significant influence in this thinking about learning comes from the epistemological theory of Jean Piaget (see especially chapter 7 of Papert, 1980). For Papert, learning occurs when students are allowed to create their own understandings and computers provide students with the tools to create their understandings. One product for education that came from Papert's work was LOGO, a computer language in which children program a "turtle" to solve geometry problems (Papert, 1972). Using LOGO becomes a process in which students think about their thinking about geometry, so learning becomes a metacognitive process for children (Papert, 1981). Jarvinen (1998) and Clements (1986) measured higher levels of operational competence, metacognitive skills, and creativity in students who learned geometry using the LOGO turtle.

Twenty years ago, Papert perceived education to be on the verge of a technology-driven revolution that sounds remarkably modern: "We are at a point in the history of education when radical change is possible, and the possibility for change is directly tied to the impact of the computer" (pp. 36-37, Papert, 1980). In these learning environments, computers would be the medium or culture within which students would think about their

world and communicate their understandings of the world. Papert predicted that radical change would occur as educators realized the new meta-cognitive learning environments arising in technology-rich environments. The radical change he anticipated never happened, but today some educators are optimistic that it may occur.

In 1993, Papert recalled three phases of the early history of educational computing. Creative teachers using computers to engage students in creative activities that were the antithesis of the CAI learning environments characterized the first phase in Papert's history of computers in education. The success of these early pioneers in the field encouraged administrators to increase the number of computers during the second phase. To maintain control over these increasing numbers of computers, administrators created centralized "computer labs" during the second phase as well. The third phase included the emergence of computer curricula that resulted in computers being viewed and taught as another subject in schools. Papert laments the early history of educational computing: "Instead of cutting across and so challenging the very idea of subject boundaries, the computer now defined a new subject; instead of changing the emphasis from impersonal curriculum to excited live exploration by students, the computer was now used to reinforce [traditional] ways" (p. 39, Papert, 1993).

The educational technologists who align their thinking with Papert and those teachers who align their thinking and teaching with the modern educational theory of Constructivism (Brooks and Brooks, 1993; Duffy and Cunningham, 1996) appear to be converging on the same learning environment. Both characterize learning as an activity in which learners create their own understandings of the world. Constructivist classrooms, sometimes called student-centered classrooms, are generally recognized as including the

use of multiple approaches and authentic data in self-directed activities. Constructivist curricula also include meta-cognitive approaches, allowing learners the time to reflect on their learning and articulate their understandings.

The convergence of educational technologists who align their thinking with Papert and Constructivists is clear enough for ISTE to have included "student-centered learning approaches" as one of the Essential Conditions to Make the Effective Use of Technology in Schools Happen (ISTE, 1999d). The convergence of Constructivist and technology-rich learning environments is also supported by a number of workers in the field of educational technology. For example, Sadler (1998), Rogers (1996), Greening (1998), Koschmann et al. (1994), and Jonassen and Reeves (1996) have all detailed the importance of sound philosophy, specifically Constructivism, in guiding the use of instructional technology. predict that without philosophical foundation computers will cause the possible improvements in school. Carr et al. (1998) argue that the use of educational technology needs to be directed by revolutionary philosophies such as situated learning and Constructivism. Kearsley (1998) suggests until the "dysfunctional ontology" that is currently directing the use of educational technology is changed, there is little prospect for creating meaningful learning environments with technology.

Sandholtz, Ringstaff, and Dwyer (1997) define stages through which schools progress as they develop into technology-rich learning environments that are aligned with Constructivist learning principles. The characteristics of schools that have progressed through those stages are summarized in a number of studies (for example: Gooden and Silverman, 1996; Schofield, 1995; Johnson, et al., 1999). These studies document shifts in the beliefs and the practices that are anticipated by the theories guiding the creation of

student-centered technology-rich learning environments. Among the changes documented in these studies are beliefs that learners construct knowledge and the perception that technology provides an opportunity for safe-risk-taking and experimentation as students construct and communicate their understandings. Also, shifting roles from teacher as lecturer to teacher as facilitator are documented, and computers are viewed as tools to find or generate authentic raw data, to communicate understanding, to visualize abstract concepts, and to support other research methods.

A number of authors have documented the changes in their classroom structure, organization and practice that has accompanied their progress towards developing student-centered technology-rich learning environments. The work of Garbinger (1996), Harlow and Johnson (1998) and Maurer and Davidson (1999) suggest designs that can be adapted to create technology-rich student-centered learning environments in all content areas and grade levels. In addition there are examples from specific content areas (for example, Galas, 1999 and 1998; Lord 1998; Rita, 1998; Connell, 1998; NCREL, 1997).

How do technology planners prepare to help educators develop professional competency?

Becker (1999) found three major factors that contribute to teachers' use of computers, specifically, the Internet in their teaching. These factors include high levels of classroom connectivity, the individual teacher's computer expertise, and the teacher's adherence to Constructivist beliefs. In collaboration with National Council for Accreditation of Teacher Education, ISTE has published a set of standards defining computer expertise for teachers. The Recommended Foundations in Technology for All Teachers (ISTE, 1999e) identify the skills and knowledge needed to become a proficient

user of computers, an effective user of computers for personal and professional growth, and a teacher able to use computers to support student learning. ISTE's foundation focuses on general capabilities such as operating computer systems and peripherals and basic troubleshooting.

The need for technology standards for teachers emerged from several observations of the state of affairs in education technology. First, even those schools that were recognized as having model programs were perceived as using educational technology inefficiently. Coughlin (1999) attributes this inefficiency, at least in part, to what could be caricatured as the "we bought the stuff... we have the stuff... we better use the stuff" approach to using education technology. The second observation leading to the development of the teacher standards was the emergence of professional competency as one of the Seven Dimensions for Gauging Progress. The third observation leading to the development of the standards was the lack of preparation in education technology observed in teachers across the nation. This lack of preparation was especially noticeable in teachers' ability to integrate technology into their instruction (U.S. Department of Education, 1999; Moursund and Bielefeldt, 1999).

In 1996, the Vermont State Educational Technology Plan included a Guide to Professional Development (Vermont Department of Education, 1996b) that makes reference to the then current version of the ISTE standards. According to that guide, the need for professional development in Vermont was not being met and the plan called for effective leadership, adequate funding, and consistent follow-up to support professional development for educators.

In order to help educators become competent users of technology and teachers with technology, professional development programs are needed. The importance of professional development is stressed in a number of technology planning handbooks (for example Boethel et al, 1998; Rockman, 1998; McNabb et al, 1999; and Office of Technology Assessment, 1995). These handbooks suggest designs for the professional development and note the importance of including professional development in technology plans, even if funding this training occurs at the expense of hardware and software purchases. Among the challenges and priorities that must be addressed when planning this professional development is a lack of funding and providing the training in the context of the curriculum and pedagogies of the school (Norman, 1999). Charp (1999) editorialized on the benefits of the increasing availability of grants to fund professional development programs, and encourages grant providers to continue to fund this important aspect of technology planning.

Dede (1997) notes that professional development that leads to meaningful integration of technology must pay attention to and introduce teachers to Constructivist principles and pedagogy as well as information technology. Meaningful professional development must be learner-centered and model meaningful learning opportunities in technology-rich environments. Bray (1999) suggests Individual Learning Plans is one way that professional development programs can provide meaningful learning in information technology for teachers in the environment of limited time and resources that characterize many professional development programs.

Galloway and Blohm (1997) note the need for teachers to become active participants in their own professional development. These authors suggest technology has

a role in providing meaningful professional development opportunities (through distance learning courses, teleconferences, and web-based professional publications), that teachers must recognize the importance of technological competence to their effectiveness and marketability, and that technology planners must include opportunities for teachers to learn how to use computers and connect technology with their teaching.

What are the factors that influence how technology-planning decisions are made in the region?

In a national study of networking, the United States Department of Energy (1996) found that networked computers helped schools connect with their communities, motivate their students, and communicate between campuses within school districts. The study also found that even schools with high levels of network use were struggling with several issues that limited the educational benefits of networked learning environments. These issues included vision, leadership, planning, curriculum, and professional development. The authors of the study identified the importance of using networks for educationally sound needs, but noted that little attention had been paid to those issues at such an early point in the history of networked computing. The study concludes that investigation is needed to foster systematic approaches to understand the many factors that influence the appropriate use of networks in schools.

The development and implementation of technology plans that promote the effective use of computers in schools requires the attention of the entire educational system "from legislative policy to classroom practice" (p. 24 Lemke and Coughlin, 1998). Vision, access, time, support and assessment are aspects of the system that must

be addressed in technology plans according to Riedl et al. (1998). The school's vision must drive the technology plan, and the system must be arranged such that there is access to computers, time for professional development in technology and teaching, technical and educational support, and assessment tools available to measure progress. Ely (1999) maintains that vision must arise from dissatisfaction with the status quo, the entire system must be committed to the vision, and effective leadership must be present for effective systematic technology plans to be developed and implemented. When reporting preliminary observations of The Road Ahead, a two-year program that included twenty-two schools in fifteen states, Moursund et al. (1998) observed some of the impediments to technology initiatives that arise from planning that does not address the issues raised by Reidl et al. and Ely.

Based on a three-year study of technology integration in primarily poor, rural schools in the southeast U.S., Byrom (1998) reports nine observations of effective technology integration, and these observations illustrate the systematic nature of the successful technology planning. In Byrom's factors, we see issues of leadership, curriculum and instruction, staffing and professional development, building, and assessment. Throughout her descriptions of the lessons learned, Byrom stresses the importance of meaningful changes based on a student-centered vision, and suggests that meaningful technology plan avoids the "reform of the month clubs" approach that can characterize educational practice.

The need for systematic attention to technology planning can also be seen in the content of a number of technology planning handbooks intended to provide pragmatic advice to technology planners (for example: Boethel, et al, 1998; Rockman, 1998; North

Central Regional Educational Laboratory, 1999 and 1999b; McNabb et al, 1999; McNabb, 1999; Graduate Students at Mississippi State University, 1996; Office of Technology Assessment, 1995; National Center for Educational Statistics, 1997). In addition, there are a number of condensed documents within this genre (for example: Anderson, 1996 and 1999; Crandler, 1996; Anderson and Perry, 1994; Thornburg, no date; and Fries and Monahan, 1998). Typically, these handbooks address the many aspects of school life, including learning, teaching, economics, and politics, that make the technology planning process so complex. Although some of these handbooks are written for specific audiences, most of the technology-planning handbooks provide similar advice to readers, and the advice includes all of the Seven Dimensions for Gauging Progress (Coughlin and Lemke, 1998).

Leadership, especially by principals (MacNeil and Delafield, 1998) and superintendents (Hunt and Lockhardt, 1998), is one important aspect of decision-making in technology planning. Fullan (1998) observes that education leaders are in a precarious position in today's schools. Leaders are charged with frequently contradictory tasks in all areas of school life, including educational technology, and they are bombarded with advice from all constituencies. The overwhelming task that arises from this situation impels educational leaders to turn to "gurus" or convene strategic planning teams with the hopes that either will provide an elegant solution to their problems. Mickelwait and Wooldridge (1996) offer criticisms of external experts that should cause education leaders to question the usefulness of the solutions offered by "gurus," and Mintzberg (1994) calls into question the usefulness of plans offered by strategic planning teams. When leaders recognize that there is no simple answer to their problems, they can begin

to take actions that will lead to meaningful change. Fullan calls these meaningful changes the "reculturing" of the school, and he claims insight into the reculturing can come from some unexpected sources such as the opinions of those who oppose the leaders' efforts, the community, and the leader's emotions, and hope.

Bailey (1997) has defined ten concepts (see Table 3) that leaders must know about in order to understand and implement technology in today's schools. These concepts are presented in a hypertext metaphor to illustrate the idea that no one of these concepts is more important than any another, and all are interconnected and evolving. Effective leadership in educational technology is characterized by leaders who empower participants to develop

Table 3. The Top 10 Concepts for Technology Integration in the 21st Century.
(from Bailey, 1997)

- Change
- Technology Planning
- Ethics
- Teaching and Learning
- Safety and Security
- Curriculum
- Staff Development
- Infrastructure
- Technical Support
- Technology Leadership

plans that address all ten concepts during the planning and implementation process. These plans will recognize the interconnectedness of the ten concepts and establish baseline information of the concepts so that measurements can be made during the process.

The estimated costs, both absolute and relative, of obtaining and maintaining computers in schools vary widely. Papert (1996) suggests that in a school that spends \$7000 per student per year, each student could be provided with a computer for \$70 per year or 1% of the school budget. Monke (1998) suggests that providing a student to computer ratio of 3.5 in the Des Moines Public Schools could cost 20% of the annual budget. Using the business concept of Total Cost of Ownership (TCO), the International Data Corp estimated that the TCO of a school with 75 computers was \$2,251 per computer in 1997 Fitzgerald (1999). The TCO is affected by expenditures such as professional development, software, maintenance and repair, connectivity and retrofitting (Consortium for School Networking, 1999), and the final TCO for schools is dependent on all of the unique aspects of the school that make simple answers to the question "How much do the computers cost?" meaningless (Ritchie and Boyle, 1998).

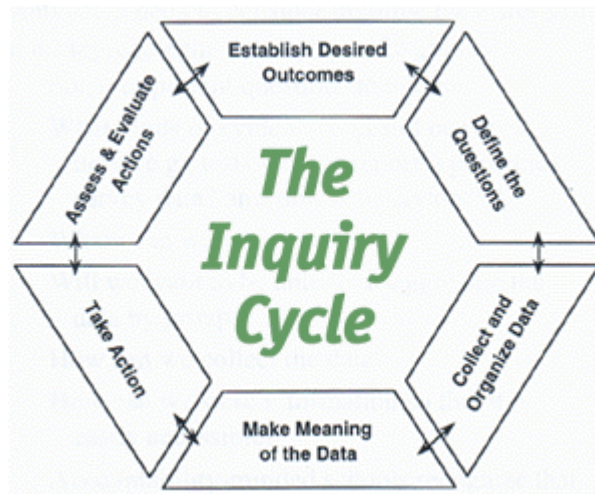
No matter whose figure we select, there is agreement that obtaining and maintaining educational technology is an expensive proposition and that there are limited funds for this purpose. As part of the Telecommunications Act of 1996, Congress established the Universal Service Program, commonly called E-rate (Education and Libraries Networks Coalition, 1999), to help provide funding to provide Internet access to school and libraries across the nation. In May 1999, the Education and Libraries Networks Coalition reported the results of a survey of the influence of E-rate on the nation's schools and libraries. That report included an overall positive assessment of the program, but noted that, even with the E-rate funding, many schools and libraries still do not have sufficient levels of connectivity. Because of the limited funds available for technology, technology planners must set priorities. As part of TechCounts'99, the

Milken Exchange for Education Technology identifies these priorities that need to be defined during technology planning: ensuring equitable yet effective connectivity, ensuring equitable yet effective technology capacity, providing leadership, and building infrastructure on state and regional levels.

Solmon and Chirra (1999) considered how resources should be distributed in the absence of special initiatives that are influencing allocation decisions. The authors identify these questions that policymakers must answer when deciding how to allocate funds for educational technology: Should we allocate according to merit or equity? Should we allocate according to socioeconomic status? Should we allocate to selected schools? Should we allocate one grade at a time? Solmon and Chirra suggest that allocating funds according to the enrollment leads to technology being distributed so thinly that there is little influence on learning. Because it leads to inequitable distribution of funds, allocation via competitive grant is not suggested. By eliminating other options, the authors conclude that allocating funds for technology to those schools, districts, or classrooms that are best prepared to use the resources will be most effective.

The role of data gathering and analysis in school decision-making is made clear by the Inquiry Cycle (see Figure 3), a part of the Tools for Accountability Project (Annenberg Institute for School Reform, 1999), which recommends that data collection

Figure 3. The Inquiry Cycle (AISR, 1999b).

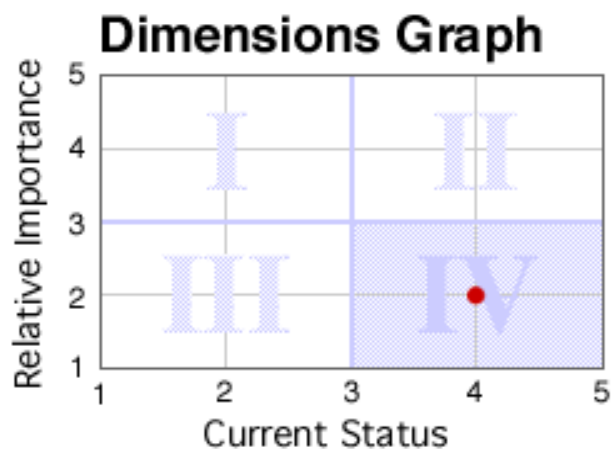


engage all stakeholders in the community, build the capacity of the school, and link schools within districts. The Annenberg Institute for School Reform suggests there are five elements that contribute to efforts to improve accountability in schools: high standards, rigorous assessment instruments, shared responsibility among stakeholders, access to adequate resources and conditions, and continuous and reflective use of data. These elements, and the process suggested by the Inquiry Cycle, provide a framework for decision-making in technology planning as well as other aspects of school planning.

A number of tools are available to facilitate data gathering in the various aspects of technology planning. The Milken Exchange's Discrepancy Analysis (Milken Exchange, 1999) is intended to help technology planners understand the progress their school is making towards each of the Seven Dimensions for Gauging Progress and to understand the relative importance of each Dimension in the school. The authors recognize that in-depth understanding of technology in schools will require a larger

variety of assessments (surveys, site-visits, focus groups, and longitudinal studies of student work are all suggested), but the Discrepancy Analysis is described as a tool to quickly assess the progress of schools in each of the Seven Dimensions. For each Dimension, a Dimensions Graph (see Figure 4) is generated and indicates the Current Status of each Dimension as well as its Relative Importance in the school.

Figure 4. The Dimensions Graph (Milken Exchange, 1999b).

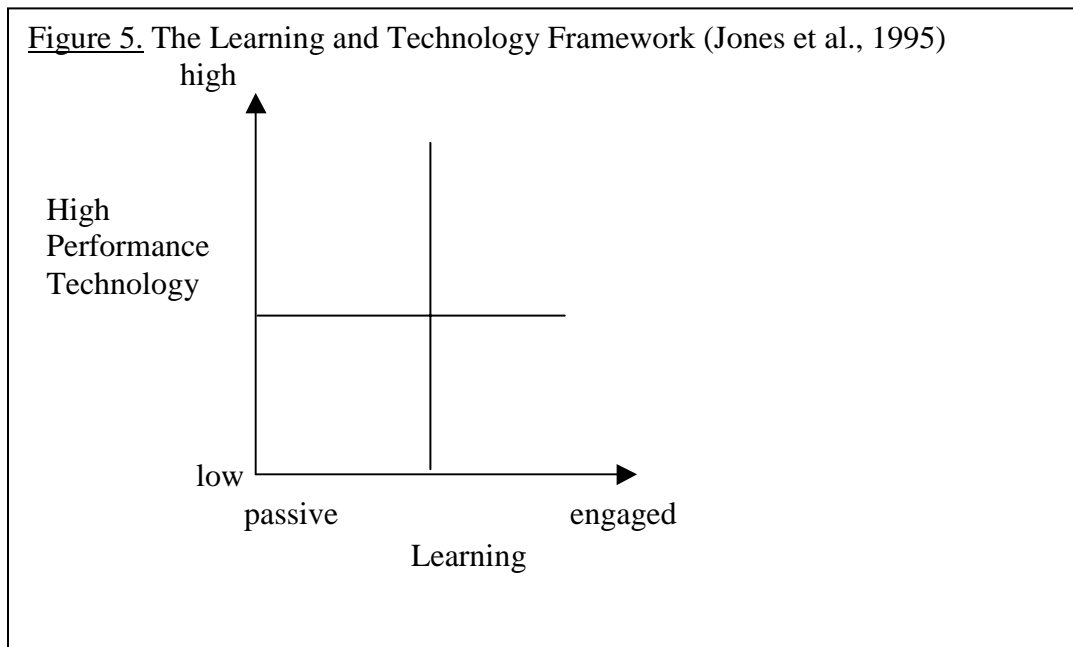


Other tools for gathering data about technology in schools are provided by a number of organizations. The CEO Forum's interactive School Technology and Readiness Chart (StaR Chart) (CEO Forum, 1999) is an on-line multiple-choice survey that includes 18 questions. The chart is promoted as a way for schools to generate a current profile, gather data to use for grant applications, set benchmarks, and determine areas of need. The North Central Regional Educational Laboratory's technology assessment tool is the Learning with Technology Profile Tool (NCRTEC, 1999). The tool presents a series of indicators of high performance, and for each indicator, there are three descriptions of the conditions related to the indicator that could be present in a school,

and respondents indicate which of the three best describes the current practice in their school.

The Milken Exchange has published the Professional Competency Continuum (PCC) (Coughlin and Lemke, 1999) as a tool to help schools assess the level of professional competence of teachers in all areas of educational technology and to guide the design of professional development programs. The PCC is organized around the areas of professional competency defined in the Professional Development Dimension: Core Technology Skills, Curriculum, Learning and Assessment, Professional Practice, Classroom and Instructional Management, and Administrative Competencies. The International Society for Technology in Education has published the Teaching with Technology Instrument (TTI) (Atkins and Vasu, 1998) which is a 46-question survey designed to measure teachers' understanding of important technology issues and guide professional development activities.

The Technology Effectiveness Framework (see Figure 5) (Jones et al., 1995) is presented as a way "educators, researchers, and policymakers can evaluate technology and technology-enhanced programs and curricula against learning goals....(p.21)." The Framework is based on the authors concepts of High Performance Technology and Engaged Learning, and users generate data for both current status and future goals. This allows technology planners to assess the kinds of planning that will help the school progress towards its goals.



An Educator's Guide to Evaluating the Use of Technology in Schools in Classrooms (Office of Education Research and Improvement, 1998) offers general advice for those charged with gathering data on the use of technology in schools. Although this document does not suggest a single specific tool for gathering data on schools, it does provide a useful overview of the options available to technology planners. This document reviews the purposes of and designs of formative and summative evaluations, as well as reviewing a variety of quantitative and qualitative research methods. Examples, focusing questions, matrices, and worksheets are used throughout the document to illustrate and explicate the evaluation process and advise technology planners through the evaluation process.

Technology: Indicators of Quality Information Technology Systems in K-12 Schools (National Study of School Evaluation, 1999) provides technology planners with advice for what to look for when assessing technological progress. Indicators are provided for assessing the teaching and learning capacity of the school and the organizational capacity of the school. In addition, the document provides a vision of

technology for student learning, a section that offers advice on documenting the planning and assessing processes, and sample performance assessments illustrating students' use of technology in authentic problem solving.

Choosing a qualitative research paradigm

This study was motivated by the fact that there has been no report of the methods and organizations used by the schools in Bennington and Rutland Counties to develop and implement technology plans. Bauder et al. (1997) identify several goals of educational research, including informing practice and providing leadership. The current study seeks to fill in the information and leadership void that results from the absence of data focusing on technology planning in southwestern Vermont. During the conceptualization phase of this project, a qualitative research paradigm was selected for a variety of reasons including the paucity of data on technology planning from the region, the purpose of the project, and the complexity of the technology planning process.

Strauss and Corbin (1990) suggest that qualitative research methods are particularly useful in situations where there is little existing data, as in this study, and the purpose of the research is to gain insight into the phenomena. Using open-ended questions is suggested as one method of gathering data to fill voids. The use of open-ended questions minimizes the influence of the researcher's assumptions and allows new, unexpected and idiosyncratic information to be gathered which can lead to inductive conclusions.

Hoepfl (1997) differentiates qualitative and quantitative research by defining the purpose of the research: "Where quantitative researchers seek causal determination,

prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations" (p.2). Considering the variety of leadership, economic, political, and educational factors that affect teaching, learning and planning in schools, it seems unreasonable to hope for causal determination (or predication or generalizations) of technology planning decisions. It does seem reasonable to seek illumination or understanding of the technology planning decisions.

Narrative data, which is collected through qualitative methods, recognizes and maintains the complexity of the processes under study (Fenstermacher, 1997). Because of this, narrative data is well suited for initial studies of complex processes, such as technology planning in schools. One drawback of narrative data is that collection can be time intensive for both researcher and participant. Informal conversations with those attending VITA-Learn meetings in the region and the state indicated that if the survey used for this project took longer than 30 minutes to complete, respondents would be discouraged from participating. In order to encourage participation with a short survey, yet allow the complex responses obtained in narrative data, the surveys were modeled after Patton's (1990) standardized open-ended interview protocols.

The Internet as a Tool for Research

Despite being a relatively recent addition to the toolbox of the modern communicator, the Internet has a history of being a useful tool for professional dialogue in educational settings and as a research tool for the social scientist. Email, listservs, and other methods of telecommunication have been found to be effective methods of professional dialogue in educational settings (for example: Sernak and Wolf, 1998;

Schagal et al., 1996; Thomas et al., 1996; McLellan, 1998; Rogan, 1997). Researchers are also beginning to use email and web-based surveys as data collection tools (Sheehan and Hoy, 1999). Several potential problems with using the Internet as a research tool have been identified, and researchers are advised to understand and address these problems when designing research. The most significant of these problems is that samples drawn from large email lists or listservs may not give representative populations (Comley, 1996). In those studies where the population is small, homogeneous, and technically savvy, however, this problem is avoided.

In a report of a study contrasting mailed and web-based surveys, Smith (1997) describes some pitfalls of electronic data collection. Among the technical problems she noted were invalid email addresses resulting in returned mail, browser incompatibility, redundant submissions due to a programming problem, and incomplete responses due to server errors. Other problems Smith noted are advertising the survey without being accused of "spamming," providing incentives to participate, and ensuring the authenticity of responses. In addition, she discusses several potential problems for researchers using electronic methods including sampling, measuring response rate, and competition. Smith also advises those using web based surveys either keep the survey short or allow for multiple submit options.

Sheehan and Hoy (1999) summarize the use of Internet based surveys tools and conclude there are several advantages to using modern telecommunications and the Internet in conducting research. The first advantage is increased reach; web-based surveys can generate a high number of responses than traditional surveys. The decreased time needed to process large numbers of surveys is the second advantage. After initial

start-up costs (for computer equipment) are recovered, or by using equipment provided for other purposes, web-based researchers also enjoy the advantage of less cost compared to users of traditional surveys. Other advantages include anonymity for respondents, and minimized potential for interviewer error.

In addition to those advantages, Sheehan and Hoy identify potential problems with web-based surveys. The major problems identified include the inability to generalize results because of unrepresentative samples and the inability to identify or prevent multiple or inappropriate responses. Despite these limits, the authors conclude email can be an effective method of surveying users, as long as researchers recognize the population that is sampled and exercise caution when generalizing conclusions. This caution is stressed when the using the Internet to gather data for large-scale projects seeking to generate samples representative of large populations.

Methodology

Population

This study focuses on the technology planning in the public K-12 schools of Bennington and Rutland Counties, which are located in southwestern Vermont. According to the 1999 Vermont School Reports that are available from the Center for Rural Studies (<http://www.crs.uvm.edu>), there are 48 schools in Bennington and Rutland Counties, including one private school that functions as a public school. That number constitutes 15% of the schools in the state, and the schools in these counties enroll 16,571 students, which is 16% of the students in Vermont schools. Most of the schools in Bennington and Rutland Counties are elementary schools (see Figure 6) and the schools tend to be organized such that several smaller elementary schools send students to larger secondary schools (see Table 4). The range of the enrollment of Bennington and Rutland County schools is from 37 students to 1,300 students, and the median enrollment is 279 students.

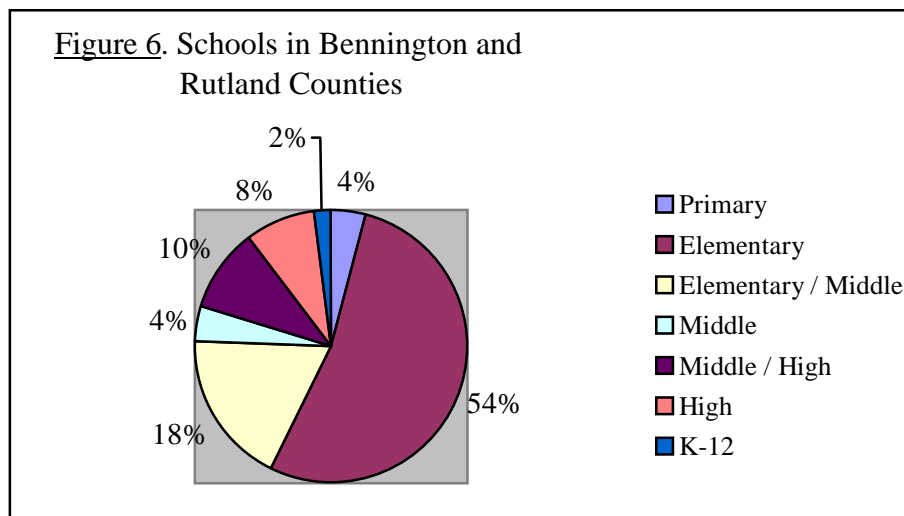


Table 4. Number of schools enrolling each grade in southwestern Vermont.

<u>Grades</u>	<u>Number of schools</u>	<u>Median Enrollment</u>
Primary Grades (1-3, EEE-2, K-2, K-3, PK-2, PK-3)	2	272
Elementary Grades (1-4, 1-5, 1-6, 3-5, 3-6, 4-5, K-4, K-5, K-6, PK-4, PK-5, PK-6)	26	173
Elementary / Middle Grades (EEE-8, K-8, PK-8)	9	294
Middle Grades (4-8, 5-8, 6-8, 7-8)	2	539
Middle / High Grades (6-12, 7-12)	5	400
High School Grades (9-12)	4	832
All Grades (K-12, PK-12)	1	468

Including classroom teachers and other teachers, the 48 schools in Bennington and Rutland Counties reported employing 1345.63 full time equivalent teachers which is 15.9% of the teachers in Vermont schools. The number of teachers in each school ranges from 2.5 teacher to 96.5 teachers with a median of 22.4 teachers. The ratio of pupils in Bennington and Rutland Counties to teachers in Bennington and Rutland Counties is approximately 12.31. The pupil to teacher ratio in the region's schools ranges from 9.7 to 20.4 with a median of 13.35. The 48 schools report employing 69.5 licensed administrators, which is 16.6% of the administrators in the state. The number of

administrators in the region's schools ranges from 0.3 to 4 with the median number of administrators being 1.

Forty-six schools in Bennington and Rutland Counties participated in the Free and Reduced Lunch Program, which is a common measure of economic need in Vermont. The lowest participation in those schools was 2.2%, the highest participation was 56.7% and the median participation was 32.1%.

In 1999, 34 Bennington and Rutland County schools provided data for their ratio of students to computers, and the ratios ranged from 2.8 to 23.6 with a median ratio of 6.4. The same number of schools provided data for their ratio of students to new generation computer. The range of those ratios was 2.9 to 182.3 with a median of 11.8. Those data do not indicate one school that reported no new generation computers, however. All of the 38 schools that provided data indicated they have Internet access and half of those reported direct Internet access.

The Sample

The sample includes 29 schools, which is over 60% of the schools in Bennington and Rutland Counties, and those schools enroll 11,346 students, which is 68.5% of the students in Bennington and Rutland Counties. Most of the schools in the sample are elementary schools (see Figure 7), and, as is typical for the region, the schools tend to be organized such that several smaller elementary schools send students to larger secondary schools (see Table 5). The range of the enrollment of the sampled schools is from 37 students to 1300 students with a median enrollment of 279 students.

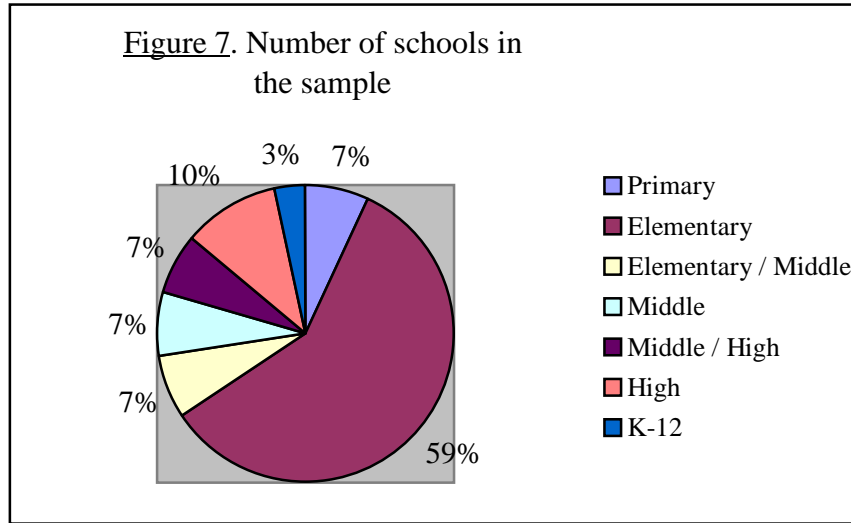


Table 5. Number of schools in each grade in the sample.

<u>Grades</u>	<u>Number of schools</u>	<u>Median Enrollment</u>
Elementary Grades (1-4, 1-5, 1-6, 3-5, 3-6, 4-5, K-4, K-5, K-6, PK-4, PK-5, PK-6)	17	234
Elementary / Middle Grades (EEE-8, K-8, PK-8)	2	523
Middle Grades (4-8, 5-8, 6-8, 7-8)	2	539
Middle / High Grades (6-12, 7-12)	2	505
High School Grades (9-12)	3	1025
All Grades (K-12, PK-12)	1	468

Including classroom teachers and other teachers, the 29 schools in the sample reported employing 898.94 full time equivalent teachers which is 66.8% of the teachers in the Bennington and Rutland County schools. The number of teachers in each school ranges from 2.5 teacher to 96.5 teachers with a median of 22.6 teachers. The ratio of

pupils in the sample schools to teachers in the sample schools is approximately 12.6. The pupil to teacher ratio in schools ranges from 9.9 to 20.4 with a median of 13.9. The schools in the sample report employing 45 licensed administrators, which is 64.7% of the administrators in Bennington and Rutland Counties. The number of administrators in the region's schools ranges from 1 to 4 with the median number of administrators being 1.

Twenty-eight schools in the sample participated in the Free and Reduced Lunch Program. The lowest participation in those schools was 6.9%, the highest participation was 56.7% and the median participation was 32.1%.

In 1999, 21 schools in the sample provided data for their ratio of students to computers. Those schools ranged from 2.8 to 23.6 with a median ratio of 7.9. The same number of schools provided data for their ratio of students to new generation computer. The range of those ratios was 2.9 to 182.3 with a median of 13.6. Those data do not indicate one school that report no new generation computers, however. All of the 23 schools that provided data indicated they have Internet access and 13 of those reported direct Internet access.

Subjects

Twenty-three individuals completed surveys for this study. Five respondents completed the district survey and eighteen completed the school survey. Two individuals completed one survey together. The surveys were completed by seven building-level administrators, three library media specialists, three teachers who also serve as building technology coordinators, one director of technology for a building, six classroom teachers (including one special educator), three district technology coordinators, and one parent

who served on a technology committee. The survey completed by one respondent was largely incomplete, it provided answers to only three questions, none of which required narrative responses. Because of the incompleteness, that survey was discarded. The surveys provide data for 17 schools and three districts, four of the schools are in districts or supervisory unions from which data was gathered.

Instrumentation

Participants in this study were directed to a page on the World Wide Web that contained one of the two surveys used to gather data for this study. One survey was written for individuals describing technology planning in individual schools (see Appendix A) and one written for individuals describing technology planning at the district or supervisory union level (see Appendix B). The surveys were accessible through linked text in all email messages or, upon request of participants, the surveys were available on a diskette or in hardcopy delivered through the mail or via fax. All of the participants choose to use the online survey. Two requested the survey on diskette, but both completed the online version when provided with that option. Two requested and received the survey via fax, but neither individual returned the survey.

Upon completing the online survey, participants used a "Submit" button on the web page to send the completed survey to the researcher in the form of an email message. Upon receipt of the completed survey, the name of the respondent was compared to a published list of employees in the school to ensure the responses were authentic, and an email message confirmed and thanked each participant. The email messages containing responses were saved as text files that were analyzed without any editing.

During the initial planning for this study, the survey was written with the intent of disseminating it via email or via diskette delivered through the mail. The individuals reviewing the prototype surveys identified potential problems that would limit the number of responses and the usefulness of the data gathered with either version. In the opinion of the reviewers, the email prototype would not be completed by participants as the message would be perceived as too long to be completed in the few minutes typically set aside for reading and replying to email. The reviewers found working with the diskette prototypes difficult, and they were not confident that their responses had been properly saved. In addition, the reviewers were concerned that packing and postage for the diskettes would dissuade participation.

Because of the reviewers' concerns, the surveys were rewritten as web pages that contained forms in which participants answered the questions and then emailed their responses. Hyperlinked text connecting the respondents to the web sites containing the surveys were emailed to the same reviewers who had previewed the initial prototypes. All reviewers indicated that the web-based surveys were easier to use and save, and resulted in more confidence on their part.

Procedures

In May 1999, each school in the Bennington and Rutland Counties received an invitation (see Appendix C) to participate in this study. The invitation was included with an invitation (see Appendix D) for principals, technology coordinators, and other leaders in educational technology to attend a reception being hosted by the Southwest Vermont Information Technology Association of the Advancement of Learning (SW VITA-

Learn), a regional organization dedicated to improving the use of educational technology in the Bennington and Rutland Counties. This invitation resulted in only four individuals agreeing to participate.

In an attempt to recruit more participants, this researcher announced and described the project to a group of teachers, principals and other administrators from the region who were participating in a week-long educational institute in July 1999. In August 1999, a list of potential participants in the region's schools was generated from participants at the workshop, conversations with SW VITA-Learn members, published names of technology coordinators and principals, and school web sites. This list of individuals received email requests (see Appendix E) to complete an online survey in early September 1999. Those schools for which no email contacts could be found received a second request to participate in the mail (see Appendix F). In the final week of September 1999, the schools that had not responded received one final request via email (see Appendix G).

Results

The results are reported in two ways. First, the responses of the participants are tallied and summarized. The intent of this method is to provide a sense of the variety of responses given by respondents from throughout the region. The second method of reporting results is a summary of the complete data received from each educational community. The intent of this method of reporting is to provide a sense of the conditions within each sampled educational community.

Data from questions related to technology capacity

The technical support available in the schools is one aspect of technology capacity for which no data is available. Because of this absence of data, the surveys gathered data on the computer technicians and technology coordinators in the regions schools, and a question asked what teachers do upon finding a broken computer.

Technology coordinators and technicians.

Because of a programming problem, the section of each survey inquiring about technology coordinators, computer technicians and the employment of those positions did not operate properly, so it is difficult to determine the number of technology coordinators or technicians employed by the schools in the region. From the descriptions of the responsibilities of the positions, it became clear that many schools continue to rely on knowledgeable teachers for the maintenance, troubleshooting, and repair of computer equipment. The same person who is the technology coordinator is likely to perform computer technician duties, and frequently, will have classroom or librarian duties as well.

The responsibilities of computer technicians in the region's schools are limited to troubleshooting hardware and software problems as the problems arise. Generally, these individuals are under the supervision of district technology coordinators who coordinate the work of the technicians. Occasionally, computer technicians are "on-call" and work only in response to requests from the schools, and frequently, the technicians are shared among schools.

The data describe the responsibilities of technology coordinators in schools and technology coordinators in districts or supervisory unions. The responsibilities are quite similar no matter the level at which the person works.

The amount of installation, maintenance, troubleshooting, and repair work completed by technology coordinators depends on the employment of computer technicians. In those schools and districts that employ technicians, the technology coordinator is more likely to coordinate the installation, maintenance, troubleshooting, and repair work than to perform it. Those with the title technology coordinator were the only individuals who appear to have network installation and administration in their duties.

Technology coordinators typically have the responsibility of researching and previewing new hardware and software and making recommendations to teachers, technology committees and administrators. Once recommendations have been made, technology coordinators have the responsibility of ordering and inventorying new purchases.

Although some technology coordinators work with students on occasion or on special projects, most of technology coordinators' teaching responsibilities include developing, coordinating and providing workshops and courses for teachers. Developing, recommending and implementing policies and procedures relating to information technology was identified as a function of the technology coordinator. Specific examples within this domain were writing, reviewing, and updating Internet acceptable use policies, and ensuring license compliance. Writing and evaluating grants including E-rate

applications, and communicating with the community were also identified as duties of the technology coordinators in the region.

Especially in smaller schools, the person who performs the duties of the technology coordinator may also teach students, or be the library/media specialist. This person is frequently a knowledgeable teacher who informally performs the duties of the technology coordinator. The percent of each person's time spent in other capacities versus technology coordinating could not be determined from the data. The technology coordinating responsibilities of these positions are similar to those of full-time technology coordinators.

What does a teacher do when he or she finds a broken computer?

All participants were asked to describe what a teacher does upon finding a broken computer in the school, district, or supervisory union. No options or prompts were provided to participants. The surveys provided data from 17 schools and three districts. Six of the schools were reported at both school level and district or supervisory union level. One school had two methods reported each by a different respondent, for that school, both methods are tallied.

In general, there are two levels of action when computers need repair (see Table 6). Typically, the first level of troubleshooting is done by a teacher or library media specialist in the school and if the problem is not resolved, then another person is called. The second person called is usually a district technology coordinator.

Table 6. Steps when teachers find broken computers.

<u>First step</u>	<u>Second step</u>	<u>Number of communities</u>
Report to library media specialist or teacher/technology coordinator	Report to the district technology coordinator	8
Report to administrator Or tech coordinator Who arranges repair	--	6
Report to student-run help desk	Report to technology coordinator	1
Inform the technology committee	Call the technician	1
Fill out work order, Repairs are posted On web page	--	1
Report the problem to a teacher	Report the problem to the technology committee	1

Data related to learning

The surveys posed two questions directly related to technology-based learning. The first question asked the different ways that computers are available in the school and the second asked respondents to describe the use of computers by students in the school.

How are computers made available?

Participants who completed the school survey were provided with a list of ways that computers can be made available in schools and asked to identify those that occur in their school. In addition, space was provided for participants to note methods not on the list. The data provided information about the availability of computers in 17 different schools. The responses were tallied for schools, so methods that were identified by more than one respondent from the same school were tallied only once.

The schools of southwestern Vermont make computers available in a variety of ways (see Table 7). In all but one school, computers are available in more than one way. Each of the schools reported that computers are available in classrooms, with 14 indicating that single computers in classrooms is one way that computers are available. Most schools, 13 of the 17, reported having a computer room.

Table 7. Methods computers are made available.

<u>Method of access</u>	<u>Number of schools reporting</u>
Single computers in classrooms	14
Computer room	13
Mini-labs	8
Computers in the library	7
Computers on carts	7
Clusters of computers in classrooms	5
Laptops	2
Computer on special educators' desks	1

Use of computers in the school.

Those who completed the survey for schools were asked to describe the typical uses of computers by students in the school. The survey provided participants with no

options or prompts, so all responses were in participants' words. Because of this, some decisions had to be made concerning the degree of similarity between responses needed to tally responses together. In general, responses that were not nearly identical were tallied separately. For those schools from which there were multiple participants, the uses that were identified by multiple respondents were tallied only once.

The data (see Table 8) provided information on the use of computers in 17 schools. The data indicate a wide range of computer-based activities is available to students in the schools of Bennington and Rutland Counties. Most of the schools report students use computers for word processing, and all of the schools report more than one use of computers by students. Of the 24 uses identified in the surveys, 16 were identified as uses in two or fewer schools.

Table 8. Uses of computers in the schools

<u>Use</u>	<u>Number of schools reported in</u>
Word processing	13
Searching the Internet	9
Creating multimedia presentations	9
Library research	8
Integrated into classroom instruction	4
Spreadsheets	4
Databases	4
Skill building	3
Touch typing	2
Email	2
Educational games	2
Enrichment & review	2
Advanced ¹	2
Process writing	1

Table 8. continued

Graphics & design	1
Web page design	1
Mathematics and writing portfolio pieces	1
Yearbook	1
WEB Project ²	1
MIDI ³	1
Links with schools and other resources	1
Electronic portfolios ⁴	1
LOGO ⁵	1
Desk top publishing	1

1- The technical center responses included program-specific, advanced uses such as accounting programs, computer aided design, and geographic information systems, and computer technology.

2- The WEB Project is a statewide visual arts program in which students use the Internet to share and receive feedback on their art work. (<http://webproject.org>)

3- MIDI- Musical Instrument Data Interface

4- One elementary school is beginning to have students compile computer-based portfolios of their work as a method of assessment.

5- LOGO- A computer language in which children program a "turtle." (Papert, 1980)

Data related to professional development

All participants were asked to identify the actions that can be taken by teachers who want to increase their use of computers do in their school, district or supervisory union. The data provide responses for 15 schools and three districts. Six of the schools are reported at the district level as well. The data include each method identified by each participant (see Table 9).

Table 9. How teachers improve their professional competence in educational technology

<u>Action</u>	<u>Number of participants reporting</u>
Talk to technology coordinator/ teacher	8
School-sponsored workshops and courses	6
School-offered after school courses	4
Make a request to principal	4
Take summer class (district)	2
VITA-Lean workshops	2
Find a course or workshop	2
Go for it on your own	2
Ask for help (unidentified)	1
Mentor (informal)	1
Teacher/leader program (formal)	1
Courses at local technical center	1
Courses at local colleges	1
Use is defined by department and school goals	1
Talk to tech committee	1

Data related to decision-making

Many of the questions on the surveys were related to the technology-planning decision-making that occurs in the school. Respondents provided information about the organizations that are in place, the process of making hardware purchase decisions, the

influences on their thinking about computers in school's, and the educational community's current goals related to technology.

Technology committees.

Respondents were asked to indicate if the school, district or supervisory union has a technology committee. In addition, respondents were provided with a list of stakeholders and asked to identify which serve on the technology committee and respondents could name stakeholders that serve on the committee who were not included on the list.

From the data (see Table 10), 17 different committees were identified. Four committees were district-wide or supervisory union-wide committees and the remaining 13 were school committees. Technology committees are typically composed of teachers, administrators, and technology coordinators (the technology coordinator is on the committee in every school that employs a person in that capacity). Two committees include six different stakeholders, and one includes eight different stakeholders.

Table 10. Composition of 17 school and district or supervisory union technology committees in southwestern Vermont.

<u>Stakeholder</u>	<u>Number of committees</u>
Teacher	17
Administrator	16
Technology coordinator	12
Parent	6
School board member	6
Student	3
Community member	3
Paraprofessional	2
Librarian	1

Respondents were also asked the frequency of technology committee meetings from a list of five choices: monthly, weekly, quarterly, as needed, occasionally. Most committees meet monthly, some less frequently, none more frequently (see Table 11).

Figure 11. Frequency of technology committee meetings.

<u>Frequency of meeting</u>	<u>Number of committees</u>
Monthly	10
Occasionally	2
As needed	3
Quarterly	2

The role of technology committees was also queried. Respondents were asked which of three roles best describes the work of the technology committee in the school, district or supervisory union. The most frequent response, although in only eight committees was to recommend decisions, the least frequent role was making decisions (see Table 12).

Table 12. Roles of technology committees.

<u>Role of Committee</u>	<u>Number of committees</u>
Recommend decisions	8
Dialogue to develop understanding	6
Make decisions	3

What or who has influenced your thinking about the use of computers in schools?

All respondents were asked to identify what or who has influenced their thinking about the use of computers in schools. Twenty-two of the participants answered this question, eight giving multiple responses. All responses of all 22 are summarized in Table 13.

Table 13. What or who has influenced respondents

<u>Influence</u>	<u>Number of participants</u>
Reading	5
Peers, associates & colleagues	5
My own use	4
Participation in professional organizations	3
Graduate work	3
Seeing benefits in schools	3
Named individual in school	3
Conferences	2
Imagination and forward thinking	1
Technology committee	1
Computer literate people	1
Experience in work force	1
Listening to staff	1
Television	1
Principal	1
In-service training	1
Experience in other schools	1

How are decisions regarding hardware and software purchases made?

All respondents were asked to identify how hardware and software purchase decisions are made in their school, district, or supervisory union. Data was gathered from

17 different schools and three districts or supervisory unions. Six of the schools were reported at the district as well. Data showed that the decision-maker is sometimes determined by the nature of the decision being made. In the schools that reported more than one method of making decisions, teachers were given the responsibility of making software decisions for their classrooms, while technology coordinators, in collaboration with administrators and technology committees, were given the responsibility of making hardware decisions (see Table 14). In the schools where there are multiple methods of making these decisions, all methods are summarized. If more than one participant from a school reported a method, it was tallied only once.

Table 14. Methods of making technology purchase decisions.

<u>Method</u>	<u>Number of schools reporting</u>
Technology coordinator recommends to administration	5
Teachers make recommendations to technology director	4
Technology committee	4
Technology plan	3
Technology committee recommends to administration	3
Teachers put software and classroom needs into budgets	3
Technology director makes recommendations to teachers	2
Teachers collaborate with technology coordinator	2
Central office administration	1
Need to upgrade	1
Available funds	1

How is data gathered?

All respondents were asked to identify the methods they use to gather data about the use of computers in their school, district or supervisory union. Twenty-two surveys provided data for 16 schools and three districts or supervisory unions; six schools

were reported at the district or supervisory union level as well. Fourteen of the 23 participants reported using more than one method to gather data about the use of computers in their school, district or supervisory union. All of the methods reported by all participants are tallied in Table 15.

Table 15. Methods of gathering information about technology in schools

<u>Method</u>	<u>Number of respondents</u>
Casual observations	7
Talking with people	6
Surveys	6
Technology coordinator	2
Reading	2
Attending workshops	2
In-house training	1
District technology committee	1
Demonstrations	1
Coursework	1
Conditions of the classroom	1
Visiting other schools	1
Computer store	1
Professional meetings	1
Voice mail/ written notes	1
Meetings with principal	1
Administrators' meetings	1
Faculty meetings	1
Internet	1
Through the mail	1
Teacher & student objectives	1

Goals for the 1999-200 schools year.

All respondents were asked to identify goals related to technology for the 1999-2000 school year. Twenty surveys provided data for 14 schools and three districts, five schools were reported at both the school and district or supervisory union level. The responses of all participants are tallied in Table 16.

Table 16. Goals for the 1999-2000 school year.

<u>Goal</u>	<u>Number of respondents</u>
Professional development	7
Add more computers	5
Finish networking	5
Increased use in classrooms	4
Upgrade existing technology	2
Introduce ISTE standards	2
Integrate computers into science curriculum	2
Increase & upgrade technology	1
"Too extensive to list, per our long range plan"	1
Install a 64 K (<i>sic</i>) line	1
Complete Staff Needs Assessment Survey and plan from the results	1
Set performance targets	1
Offer training in community	1
Maintain network	1
Create a web site	1

Table 16. continued

Automate library	1
Increase access	1
"We have not set any"	1
Update technology plan	1
Define technology curriculum	1
Increase administrative uses	1
More equitable access in homes	1
"Not sure, they change frequently"	1

Profiles

The second method of reporting data is profiles of the educational communities sampled. These brief descriptions of the educational communities were created from two sources of data. First, data regarding the demographics and technology capacity of the community were drawn from the Vermont School Reports. The demographic data summarized in these profiles includes the grades in the school, the enrollment, the number of teachers, pupil to teacher ratio, participation in the free and reduced lunch program, student to computer ratio, and student to new generation computer. These data are reported both as raw data and as percentile rank (PR), which compare the school to all schools in Vermont. Second, data from the respondent or respondents from each educational community are paraphrased. For those communities that were described by multiple participants, the data from all respondents are combined into one profile.

Educational community #1.

A single respondent described this large secondary school (see Table 17). The school has a direct link to the Internet and very low student to computer ratios.

Upon finding a broken computer in this school, teachers turn first to the student-run help desk that provides initial troubleshooting and technical help in this school.

Unresolved problems are referred to the computer technician for diagnosis and repair.

Grades in the school	Enrollment		# of teachers		Pupil: Teacher ratio		Free & Reduced Lunch Actual PR	Student: Computer ratio		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR		Actual	PR	Actual	PR
9-12	462	78	46	87	11	16	Did not participate	2.8	2	2.9	3

Computers are available to students in a number of ways in this school. The list includes a computer room, mini-labs, computers on carts, single computers in classrooms, and laptops. The school has a comprehensive long-range technology plan that includes plans for increasing technology capacity, increasing the professional competency of teachers, and guiding the integration of technology into the curriculum. Planning, designing, and training for the implementation of all aspects of this plan are the responsibility of the full-time technology coordinator in this school.

The school's technology committee includes teachers, administrators, students, parents, school board members, and the technology coordinator. The committee meets monthly to make decisions. Planning for the integration of computers into instruction in all content areas is a collaborative process that involves many people and is directed by the long-range technology plan. Sharing information and planning for the integration of computers into instruction is a bi-directional process in this school with teachers making recommendations to technology coordinator and the technology coordinator making

recommendations to teachers. Teachers make curriculum specific technology recommendations to the department chairs and the department chairs communicate those recommendations to the technology coordinator. In addition, the technology coordinator researches and previews hardware and software and prepares technology demonstrations for teachers in specific departments.

A variety of formal and informal methods are used to gather information about the use of technology in the school. Surveys, discussions at department meeting, informal observations of teachers and students, as well as formal reviews of teachers individual professional development plans are all methods employed to gather data. The respondent did not specify technology-related goals for 1999-2000 school year.

Educational community #2.

This supervisory union is described by a single respondent who identifies his previous experience with computers and students, especially working with students using computers on creative writing assignments as influencing his thinking about computers in schools. The supervisory union is composed of several small elementary schools that send students to large middle and high schools (see Table 18).

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6 ¹	318	60	22.4	54	15.6	16	34.6	60	-	-	-	-
K-6 ²	413	78	30.4	67	14.5	72	54.5	89	7.9	78	7.9	25
K-6 ²	397	70	28.75	65	14.8	78	50.4	86	-	-	-	-
K-6 ²	168	32	8.85	15	20.4	99	13.1	15	3.2	7	5.6	8
K-6 ¹	37	3	2.5	2	16.1	88	54.1	89	-	-	-	-
K-6 ³	176	34	13.7	34	14.5	72	34.7	61	13.5	-	96	-
K-6 ²	325	61	19.1	45	18	95	37.2	67	3.4	11	0	0
7-8 ¹	656	90	49.5	89	14.4	71	23.2	35	-	-	8.6	31
9-12 ²	1300	100	96.5	98	14.5	72	22.2	34	23.6	100	39.4	92

1- Schools that did not report Internet access in 1999

2- Schools that have direct links to the Internet

3- School with a cable modem

Although the respondent describing this educational community completed the district or supervisory union survey, which does not specifically ask about the use of technology teaching and learning, it became clear that teaching and learning do drive the technology decisions in this supervisory union. Specific examples of the importance of teaching and learning driving technology decisions technology include the following: Integrating technology into the science and literacy programs is the stated focus of the current science curriculum and literacy curriculum projects in the district. In addition, "second tier" courses which focus on the integration of applications into classroom work are included as part of the on-going professional development work in the district. Finally, the respondent gave the example of a social studies teacher who wanted to increase Internet access in the classroom, so a hub was purchased to connect his classroom computers to the Internet.

The school district employs a full-time technology coordinator to coordinate and plan the technological growth of the supervisory union and two full-time computer technicians to maintain, troubleshoot and repair computers and networks. Repairs are coordinated via a systemized procedure of reporting and repair work is scheduled and jobs are coordinated via the school's web page.

As seen in the relatively low student to computer and student to new generation computers in most of the schools in this educational community, creating schools with high technology capacity is a high priority in this supervisory union. The respondent indicated that 200 new workstations had been purchased by the school district for the beginning of the 1999-2000 school year, which further illustrates the attention paid to

technological capacity in this supervisory union. Despite the attention paid to technology capacity, some schools have obvious technical deficiencies: One of the schools in this educational community reports no new generation computers, and the high school's student to new generation computer is in the ninety-fifth percentile.

Improving the use of technology appears to be a system-wide goal in this educational community. For more than five years, courses and workshops have been offered to allow teachers to develop their professional competency, and the opportunities have provided experience to all teachers to develop the skills necessary to become skilled users and to understand how to use computers to influence learning in the classroom.

Assessing technological need and recommending purchases is done in individual schools in the supervisory union, but the supervisory union technology coordinator and finance manager review the recommendations and coordinate the process. Purchases are made through the technology coordinator and finance officer who consolidate orders and solicit bids or competitive quotes from vendors. The data from this educational community contains no mention of measuring progress towards recognized standards in educational technology, but the supervisory union does have formal methods of learning about instructional technology within its educational community. Surveys are used to gather information about the professional development needs of the teachers, and the use of information technology to achieve students and teacher objectives is a part of teacher observations. The technology-related goals for the 1999-2000 school year focus on continuing professional development.

Educational community #3.

This is a large elementary school (see Table 19) is described by two respondents who completed a single survey. Both respondents named a single person on the staff of the school as being very influential in the respondents' thinking about computers in schools. This school has a direct link to the Internet.

Table 19. Data describing educational community #3

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-8	559	86	45.4	87	13.2	53	32.1	53	12.7	94	17.5	69

In this educational community, computers are available in computer rooms, as single computers in classrooms, in mini-labs, and on carts. Students use the computers for word processing, "skill and drill" software applications, Internet-based research, developing multimedia presentations, and (beginning in the 1999-2000 school year) pilot programs using electronic portfolios to document their work.

In addition to developing and implementing curriculum that is based on student technology standards for students through grade eight, the technology teacher serves as the technology coordinator. In addition to teaching, her responsibilities include maintaining the computer and network equipment, preparing technology budgets and ordering hardware and software, and developing forms, policies and procedures. She also is responsible to providing (or arranging outside instructors for) workshops and courses for teachers' professional development, and she is a vital part of the long-range technology planning process. All technology needs surrounding technology are directed through this person, who uses an "on-call" technician for troubleshooting and repairing those problems she cannot.

The school's technology committee consists of teachers, administrators, students, parents, school board members, community members, paraprofessionals, and the technology coordinator. The committee meets monthly to dialogue to develop understanding. The planning and purchase process is collaborative and bi-directional in this school. The technology teacher/ technology coordinator and teachers team up to discuss educational needs and available technologies before purchase recommendations are made to the principal. The principal communicates those recommendations to the school board, where, the respondents claim, "we win some, and we lose some."

Surveys and casual observations are used to gather information about technology use in the school. All teachers are encouraged to participate in conferences and workshops in educational technology and the building leaders in educational technology read books and trade magazines to keep apprised of current trends in technology. Information is also shared with and though the supervisory union technology committee, which includes the active membership of representatives from this school.

Goals for the 1999-200 school year include continuing to develop learning opportunities for students and faculty, and guiding this work with unspecified technology standards, continuing to increase the technology capacity of the school, and continuing to use the school's network for internal communications and administration.

Educational community #4.

Three individuals described this supervisory union, which includes a large secondary school and several smaller elementary schools (see Table 20). One respondent who identified teachers and students as influencing his thinking about computer in schools described the technology planning in the entire supervisory union and two of the

elementary schools were described by separate individuals. All of the schools in the supervisory union have dial-up access to the Internet. The supervisory union technology committee consists of teachers, administrators and the technology coordinator that meets monthly to dialogue to develop understanding.

Table 20. Data describing educational community #4

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6	297	57	25.5	59	12.6	41	26	39	8	78	12.9	53
K-6	117	21	12	28	10.6	11	22.4	34	5.3	46	8.4	29
K-6	204	39	18.5	43	12.4	37	28.4	45	4.6	35	7.3	22
7-12	797	93	56.5	92	14.9	79	16.7	23	8.6	81	22.1	0

The district technology coordinator plays a central role in the technology planning in this supervisory union. He is responsible for making recommendations on all technology initiatives. Specific responsibilities include coordinating e-rate and other grant applications, consolidating and placing orders, and installing, maintaining, troubleshooting, and repairing computer hardware including network administration. In addition, the technology coordinator coordinates and provides in-service training in educational technology throughout the supervisory union.

Upon finding a broken computer in any of the schools in this supervisory union, a teacher notifies the library/ media specialist in the school. The library/media specialist will attempt to diagnosis and repair that computer, and if the problem is unresolved, the library/median specialist calls the district technology coordinator who performs the repair.

Decision making on technology issues is made primarily through the technology coordinator who receives input from teachers and students. The technology coordinator researches the technology that is available to meet the needs of the teachers and students,

then makes appropriate recommendations to school administrators. The technology coordinator gathers data about technology during routine visits to the schools in the supervisory union. In addition, teachers and other faculty make formal recommendation to the technology committee and the technology coordinator. The supervisory union's goals for the 1999-2000 school year include providing professional development opportunities for teachers to develop their own computer skills and to develop skills using computers for teaching.

One of the elementary schools in this supervisory union was described by an individual who identifies a specific individual in her school as well as her experience with children and computers as influential in her thinking about computers in schools. The school has a technology committee that consists of teachers and administrators and the committee meets monthly to dialogue to develop understanding.

The school has two networked computers in each classroom and six networked computers in the library. Students in this school use the computers for word processing, creating multimedia presentations, Internet-based research, and some work with spreadsheets, design and graphics. In addition, some teachers use software applications related to the curriculum to support instruction.

In this school, the library media specialist is the first contact for computer repairs and for providing support to teachers, but the supervisory union technology coordinator does significant troubleshooting and repair work in the building. Purchase decisions are made through discussions involving teachers, the supervisory union technology coordinator, administrators, and the library/ media specialist.

In this school, data regarding technology use is gathered through surveys, observations, and discussions at both faculty and team meetings. This elementary school's goals for the 1999-2000 school year include giving a Staff Needs Assessment and designing professional development plans according to the results and developing performance targets for students based on the ISTE standards.

Another individual, who identifies experiences in the classroom and in-service activities in educational technology influencing her thinking about computers in schools, described the technology planning in a second of the elementary schools in this supervisory union. This second elementary school has a technology committee consisting of teachers, administrators, and the technology coordinator. The committee meets occasionally to recommend decisions. In this school, computers are available as single computers in classrooms, in mini-labs, and as computers on carts. Students use the computers for word processing, Internet-based research, telecommunicating with students in other schools and scientists, and students use software applications for skill development and practice.

In this elementary school, the technology coordinator, who is also the library / media specialist, assists students who are working on computer-based projects. The library media specialist also maintains computer equipment and serves as the initial troubleshooter, provides in-service training, and previews software and recommends software purchases

Both the building technology coordinator and the supervisory union technology coordinator are available to advise those teachers interested in increasing the use of computers in their teaching. In addition to using these resources, teachers enroll in

outside courses, and the respondent indicated "going for it on your own" is another option that is exercised by teachers in this school.

Hardware and software purchase decisions are made based on the technology committee's plan and input gathered at staff meetings. The respondent did not indicate any technology-related goals for the 1999-2000 school year.

Educational community #5.

This is elementary school that is about average size for the state of Vermont (see Table 21) is described by a single respondent who indicates that his thinking about computers and students is influenced by the input of his colleagues. There is no report of this school's Internet access in 1999. The respondent made no mention of a technology committee in the school.

Table 21. Data describing educational community #5												
Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6	234	45	22.27	53	10.9	15	23.9	35	-		-	

Computers are available in a computer room, as single computers in classrooms, and in mini-labs. Students use the computers to learn to keyboard, word processing, LOGO, and some spreadsheet and database activities. The technology teacher/technology coordinator plays a central role in the technology planning of the school. He is the resource for maintaining, troubleshooting, and repairing equipment, he helps teachers with professional development and recommends hardware and software purchases. Information is gathered via informal discussions and an occasional paper questionnaire.

The respondent indicates two technology-related goals for the 1999-2000 school year. Those goals include the completion of a networking project and adding a few new computers.

Educational community #6. This elementary school that is larger than average for the state of Vermont (see Table 22) is described by a single respondent who named a colleague who has been influential in her thinking about technology in schools. The school has dial-up access to the Internet. This school's technology committee consists of teachers and it meets monthly to recommend decisions. In this school, computers are available in a computer room and as single computers in classrooms. Students in this school use computers for word processing, working with databases and to create multimedia presentations.

Table 22. Data describing educational community #6

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6	308	59	23	55	14.3	70	32.8	54	7.7	75	10.6	43

The library/ media specialist in this school has taken on the "overwhelming" work that is typically done by both technology coordinators and computer technicians. This individual troubleshoots and repairs computers to the best of her abilities, which she admits are taxed by the current demands of the school's technology. In addition, she provides instruction to those teachers who are looking for help with their own computer use.

Decisions regarding technology purchases for the school are made as funds become available, and the focus is on updating equipment. Surveys and observations are

used to gather information regarding technology use in the school. Technology related goals for the 1999-2000 school year include becoming more connected both internally and to the Internet and to automate the library.

Educational community #7.

This small secondary school which is smaller than average for the state (see Table 23) is described by a single respondent who identified professional reading and conversations with others, especially technology coordinators with whom she has frequent interactions as being influential in her thinking about computers in schools. The school has a direct link to the Internet. The school's technology committee consisting of teachers and other interested parties meets on occasion to discuss "vision and to answer the question: Where do we want to go from here?" The school district's technology committee, which consists of teachers, administrators, and the technology coordinator and meets as needed, is influential in technology decisions made in the school.

Table 23. Data describing educational community #7												
Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
7-12	213	41	22.6	55	10.2	7	20.2	28	3.5	15	6.5	15

The building technology coordinator is also the technology teacher. This person's responsibilities include teaching classes, and organizing and maintaining existing computer equipment, including the network. In addition, this person investigates new technology and recommends and organizes new purchases. Teachers turn to the technology coordinator for troubleshooting printers and other hardware, as well as for advice on using computers in classrooms. The technology coordinator also is involved in

writing grants and reporting on activities using funds obtained from grants. The school also has a part-time technician who assists with repairs as needed and serves as a resource for the technology teacher/ coordinator.

In this school, computers are available in computer rooms, single computers in classrooms, and clusters of computers in classrooms. Students in the school use these computers to conduct research on the Internet, word process papers, and create multimedia presentations.

When teachers find a broken computer in the school, they report it to the technology teacher/coordinator (frequently in the middle of classes). Minor problems are fixed immediately, others are added to the "to do" list of the technology coordinator/ teacher or added to the list of problems for the technician to address. Teachers who want to increase their use of computers in the classrooms can talk to the technology teacher/coordinator who provides individual or group instruction, connects the teacher with a mentor, or researches outside training options.

Hardware and software purchases are usually made when funds are available. The technology coordinator/ teacher will advise and collaborate with teachers to define need and then seek the input of the technician when determining the technology that is available to meet the needs, planning purchases and consolidating orders. Information about the use of computers in the school is gathered via informal observations.

Technology-related goals for the 1999-2000 school year include offering introductory technology courses for teachers, updating the supervisory union technology plan. In addition, there are plans for increasing the technology capacity of the school by ensuring at least one computer for each classroom, and connecting the town's schools and

library to a wide area network, and providing access to the Internet through the wide area network (WAN). A specific curriculum project mentioned by the participant is the development of a technology-based science curriculum.

Educational community #8.

This school district consists of average-sized elementary schools and a large secondary school (see Table 24). Several respondents described this educational community. One individual, who identified professional reading and colleagues, including other technology leaders in the region as influencing his thinking about computers in school, described technology planning on the district. Several individuals described the technology planning activities that occur in some of the schools that compose this district.

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-2	276	52	20	47	14.5	72	56.2	90	13.1	95	14.5	62
K-2	268	51	19	44	14.9	79	56.7	91	19.1	100	22.3	81
3-6	729	91	52.5	91	13.9	63	56	90	13.8	98	182.3	100
7-8	405	72	31	68	13.5	57	32.1	53	8.3	79	33.8	90
9-12	1025	97	95	98	11.5	20	16.1	21	10.3	89	48.8	95

All of the schools in the district have direct access to the Internet. The district technology committee consists of teachers, administrators, parents, school board members, and the technology coordinator. The committee meets monthly to recommend decisions.

The district technology coordinator is responsible for operating the district's wide area network, supervising computer teachers, providing hardware and software support

for the staff, and leading the technology committee. Computers in need of repair are reported to the district technology coordinator who either dispatches the computer technician or repairs the computer himself. The district technology coordinator also coordinates professional development in educational technology, which includes after-school and summer workshops and graduate courses.

The district technology committee and the technology coordinator make hardware purchase recommendations to the administration. In the district, data about computer use is gathered through discussions with staff, written surveys, and through discussions at administrator's meetings. Technology goals for the district for the 1999-2000 school year include extending Internet connectivity into each instructional area in the district, continuing to offer in-service training to faculty and staff and increasing the use of and integration of computers in instructional areas.

One of the elementary schools in the district, one that is about average sized compared to Vermont schools, was described by an individual who identifies her interactions with others who use computers as influencing her thinking about computers in schools. This school does not have a technology committee. Computers are available as single computers in classrooms and in a cluster of three computers in the library. Students use the computers during free time or on a rotational basis throughout the day. The respondent did not indicate the nature of students' work on the computers.

In this school, one of the teachers is the first contact for troubleshooting broken computers, if she is unable to resolve the problem, then she contacts the district technology coordinator who completes the repair himself or assigns the district computer technician to make the repair. The same teacher is the initial contact for teachers who are

seeking advice on using computers in classes, but many of the elementary schools' faculty take advantage of district-sponsored workshops and courses in educational technology.

In this building, individual teachers make software purchase decisions as part of the regular annual budget process, and all hardware purchases are made through the district technology committee. Informal observations and discussions with teachers are used to gather data about computer use in the school. No goals related to educational technology have been set for this school for the 1999-2000 school year.

The largest elementary school in the district is described by an individual who identified her studies in her graduate program, participation in professional conferences, and professional readings as influencing her thinking about computers and school. This school has a technology committee that consists of teachers, administrators, the librarian, and the technology coordinator. Computers are available in computer rooms, as single computers in classrooms, and in the library. Students use the computers for word processing, Internet-based and CD-based research, and for spreadsheets in grades five and six.

The building technology coordinator also serves as the library/ media specialist. This person's technology responsibilities include initial troubleshooting, consulting with students and faculty who are completing computer projects, planning technology related staff development, and recommending hardware and software purchases.

In this large elementary school, data related to technology is gathered via informal conversations, the telephone, meetings between the building technology committee and the principal, and meetings between the technology coordinator and the principal. This

school's technology goals for the 1999-2000 school year include increasing the use of computers in the classroom curriculum. This training will focus on integration so that computer activities are not used as "add-ons," but as part of the regular classroom curriculum.

Three individuals described the middle school in the district. This first individual identified his own use of computers, as well as specific named colleagues as influencing his thinking about computers and schools.

According to this respondent, the school has a technology committee that consists of teachers, administrators, and the technology coordinator and it meets monthly to recommend decisions. Computers are available in a computer room and as single computers in classrooms, and students in this middle school use the computers for word processing and creating multimedia presentations.

The technology coordinator is responsible for purchasing and installing the hardware that is purchased for the building according to the district technology plan. The technology coordinator is also responsible for implementing the technology initiatives of the administration.

Those teachers who are interested in increasing their use of computers usually take advantage of district technology courses. Some teachers in the school take advantage of courses offered by outside agencies such as the area technical center, local colleges, or the Vermont Information Technology Association for the Advancement of Learning.

The respondent indicates data about computer use in this middle school is gathered through site visits to other schools, reading computer journals and through

professional meetings and conferences. The respondent is unsure of goals for the 1999-2000 school year, and indicates that such goals change frequently.

The second individual to describe the technology planning in this middle school individual identified other teachers, professional conferences and meetings, and television as influencing his thinking about computers in schools. According to this respondent, the school has a technology committee that consists of teachers, administrators, parents, school board members, and the technology coordinator, and the committee meets monthly to recommend decisions. This respondent indicates the school has computers available in a computer room, as single computers in classrooms, in mini-labs, on carts, in addition to a few laptops. Students use the computers for word processing, Internet-based and CD-based research, creating multimedia presentation (which includes using scanners and video capture cards), creating spreadsheets and databases, publishing print and electronic media, creating soundtracks to accompany student performances, and interfacing to gather experimental data in science labs.

The technology coordinator is responsible for maintaining and upgrading computer and network equipment throughout the district. In addition, this person is responsible for communicating between staff and administration and between the school district and community to set goals for the "intelligent expansion and evolution of the technology program." Organizing and offering the extensive professional development opportunities in educational technology is yet another responsibility of the technology coordinator.

Upon finding a broken computer in this middle school, a teacher will approach the building technology teacher who troubleshoots and repairs the equipment or, if he is

unable to resolve the problem, arranges for the district technician or coordinator to make the repair. In addition, the building technology teacher instructs faculty, both formally and informally, in basic troubleshooting steps.

Those teachers interested in increasing their use of computers can take one of the many courses offered by the district. The respondent praised the quality of these courses, which are characterized by very knowledgeable instructors who are flexible in their approach and delivery which makes the courses valuable for those at all levels of expertise.

According to this respondent, the technology committee recommends hardware purchase decisions, and the administration and school board votes to accept or table the recommendations, or occasionally the administration or school board will return recommendations to the technology committee for further review. This respondent indicates the middle school's technology goals for the 1999-2000 school year include increasing the technology capacity through the installation of new workstations and defining benchmarks and skill expectations for students.

The third individual to describe technology planning in the middle school identified his own learning about computers and observing the effects of computers in classroom learning as influencing his thinking about computers in schools. This respondent indicates there is no technology committee in the school. The respondent indicates the school has a computer room, single computers in classrooms, and computers on carts, and students use the computers for word processing, Internet-based research, and through an unspecified information technology curriculum.

The district technology coordinator supports technology in the middle school through meetings with the district technology committee and the building technology teachers to discuss technology concerns. In addition, the district computer technician and technology coordinator assist with installing, troubleshooting, and repairing computer and network hardware in the building.

When teachers in the middle school find broken computers, they first report the problem to the building technology teacher who troubleshoots and repairs most problems. Teachers who are interested in increasing their use of computers in their teaching can take one of the many district-sponsored courses or workshops.

The district's five-year technology plan describes hardware purchases for the building, and teachers make software purchases as part of the normal budget process. Coursework and discussions with colleagues are used to gather information about computer use on the school. The school's technology goals for the 1999-2000 school year include helping teachers become more familiar with the use of computers for administrative and housekeeping duties and helping teachers increase their knowledge of the capacity of available computers.

Educational community #9.

This large elementary school (see Table 25) is described by a single respondent who identified previous experience in other schools as influencing his thinking about computers in schools. There is no current data describing the technology capacity, including Internet connectivity in the school. The school's technology committee consists of teachers, administrators, parents, and the technology coordinator. The committee meets monthly to recommend decisions. In this school, computers are available in a

computer room and as single computers in classrooms. Student uses the computers "for research projects, to reinforce skills, particularly at the primary and elementary levels, and to enhance instruction for enrichment and review at all levels."

Table 25. Data describing educational community #9												
Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-8	486	80	37	78	13.9	63	14.9	20	-		-	

The technology coordinator oversees the school's computer hardware, recommends software purchases and offers in-service training to faculty and staff on a periodic basis. Technology planning appears to be informal and inclusive in the school. Repair needs are reported to the principal or the technology coordinator, and needs for professional development are resolved collaboratively between the teacher and the principal. The principal recommends hardware and software purchases to the school board after hearing input from teachers, the technology committee, and the technology coordinator. Information about educational technology is gathered through surveys, and discussions at faculty meetings that are attended by the technology coordinator. In addition, formal reports are made to the principal or the technology coordinator. Technology-related goals in this school for the 1999-2000 school year include installing a 64K (*sic*) line to increase connectivity, and to offer training specifically in PowerPoint.

Educational community #10.

This small elementary school (see Table 26) is described by a single respondent who identified his own computer use as influencing his thinking about computers in schools. This small elementary school has dial-up access to the Internet. The school's

technology committee consists of teachers and administrators and the committee meets as needed to make decisions. In this school, computers are available as single computers in classroom. Students use the computers for reference, conducting Internet-based research and playing educational games.

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
PK-6	114	19	9.67	20	13	47	6.9	3	7.6	74	14.3	62

When computers are beyond the repair of the members of the technology committee, the problem is added to a list that is attended to when the computer technician makes a weekly visit to the school. The committee also meets to discuss and decide on hardware and software purchases for the building. This school's technology goals for the 1999-2000 school year include making computers more accessible to students, increasing the use of computers by students, and improving the speed and reliability of available Internet access.

Educational community #11.

This large K-12 school (see Table 27) is described by a single respondent who identified "imagination and forward thinking" as influencing her thinking about computers in schools. The school has dial-up access to the Internet. The school's technology committee consists of teachers, administrators, students, parents, school board members, and the technology coordinator. The committee meets quarterly to recommend decisions.

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-12	469	79	41	83	12.3	33	32	52	8.7	82	58.5	96

Computers are available in computer rooms, as single computers in classrooms, and in the library. Throughout the grades and across the curriculum, students use computers for word processing and creating multimedia projects. Computer-based activities in specific grades and content areas include work on the yearbook, math and writing portfolio pieces, the Web Project for art students, activities in grade five history studies, and MIDI-based music activities in grades seven and eight.

The technology coordinator actively participates in the technology planning process and serves as the computer technician. After consulting with the principal and the technology teacher, the technology coordinator researches hardware and software products and makes purchase recommendations to the technology committee. In addition, the technology coordinator arranges for purchases, installs, maintains, troubleshoots, and repairs all computer equipment.

Requests for repairs are made informally to the technology coordinator. Requests for professional development are directed to the principal who makes efforts to meet all requests. The technology plan defines procedures for gathering information about the use of computers in the school, but the respondent did not describe procedure. The respondent did not indicate any technology-related goals for the 1999-2000 school year.

Educational community #12.

This small elementary school (see Table 28) is described by one respondent who identifies professional reading, conferences, peers, and associates as influencing her

thinking about computers in schools. The school has a direct link to the Internet. The school's technology committee consists of teachers, administrators, school board members, and it meets as needed to recommend decisions. In the school, computers are available in a computer room and in mini-labs. Students use the computers for research, especially on the Internet, desktop publishing, creating multimedia presentations, and for email.

Table 28. Data describing educational community #12												
Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6	155	30	16.7	39	9.9	5	41.3	74	4.4	32	5.5	8

There is no technology coordinator in the school. The technology committee brainstorms solutions to repair problems and the technology committee also makes hardware and software purchase decisions. The principal encourages professional development, and the school utilizes VITA-Learn sponsored activities in their school and in others schools to help teacher develop professional competency. In addition, the school's teacher leader program is used to encourage professional development in educational technology. The small size of the school makes technology need very obvious and communication about technology needs very easy.

This elementary school's technology goals for the 1999-2000 school year include developing greater expertise within the faculty, encouraging more equitable access for parents and students at home, and increasing the use of technology in every classroom.

Educational community # 13.

This small elementary school (see Table 29) is described by a single respondent who identified her participation in graduate level courses and "seeing the benefits" as

influencing her thinking about computers in schools. The school did not report information regarding technology capacity including Internet access in 1999.

Grades	Enrollment		# of teachers		Pupil: Teacher		Free & Reduced Lunch		Student: Computer		Student: New Generation Computer	
	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR	Actual	PR
K-6	136	25	11.4	27	12.6	41	50.7	86	-	-	-	-

This elementary school has a technology committee that consists of teachers, administrators, parents, school boards members, community members, and the technology coordinator. The technology committee meets monthly to recommend decisions. Each classroom in this school has computers available; the number of computers in classrooms varies between one and three. In the school, some computers are available on carts as well. Students in the school use computers for research, process writing, and to "reinforce skill-building."

The school has a part-time technology coordinator who has the responsibility of installing, maintaining, troubleshooting and repairing the school's computer hardware and network. The technology coordinator also provides formal and informal professional development for teachers. In addition, the technology coordinator participates in planning meetings and maintains the school computer inventory.

Teachers inform the technology coordinator of broken computers, usually via a note, and then the teacher waits for the technology coordinator to make the repair. Teachers who want to increase their use of computers make requests for professional development through the principal. The faculty and staff keep up to date regarding educational technology by attending conferences and workshops, through mailings from

various organizations and businesses involved in educational technology, and through the knowledge of the technology coordinator.

After hearing the input of teachers, the technology committee is in the process of reassessing the hardware and software needs of the schools in order to update the school's technology plan. Other technology goals for the 1999-2000 school year in this school include creating an active web site, and offering training for "students, staff, and the community."

Educational community # 14.

One individual described the technology planning at one of the technology centers in the region. Because data on technical centers is not included in the Vermont School Reports, the demographic data for this school is not included. He identified the needs of the population served by the school and input of the teachers in the building as influencing his thinking about computer in schools. This technical center has a technology committee that consists of teachers, administrators, and the technology coordinator. The committee meets quarterly to recommend decisions. The respondent did indicate that the technology planning done for this building occurs independently of the technology planning of sending schools and the host district, although efforts are made to be inclusive in the technology planning process and to communicate the decisions with all associated schools.

The technical center has a number of state-of-the-art computer rooms in addition to having single computers available in classrooms, mini-labs, and computers on carts. The use of computers is integrated into the program areas, and is specific for each area.

Examples of computer-based activities within the programs include computer-aided design (CAD), geographic information systems (GIS), and business applications.

The technology coordinator serves as network administrator as well as ordering, installing, and coordinating the repair of all computer equipment. In addition, the technology coordinator recommends technology policy to the director of the technical center.

Technology purchases are made based on collaborative discussions between the technology coordinator, the director, and the technology committee. Plans and priorities are set a year in advance of purchases and final decisions are made based on the availability of funds. Input into purchase decision comes from many sources including instructors who work in business and industry and research conducted upon the request of the director. Technology-related goals for the 1999-2000 school year include upgrading hardware and software in several program areas.

Summary and Implications

As expected, the schools sampled for this project use a variety of methods and have in place a variety of organizations to develop and implement technology plans. The planning activities recorded in the data do seem to indicate a balance between planning for technology acquisition, or planning to increase technology capacity, and planning to address the use of technology in classrooms. This balance is contrary to the stated hypothesis. The data also give insight into the complexity of the technology planning process in Bennington and Rutland County schools; that complexity was anticipated when reviewing the literature. The data are analyzed within the framework provided by the research questions.

Themes related to technology capacity

Technology capacity includes the nature of the technology that schools have available as well as the support provided to users of technology. Coughlin and Lemke (1998) define various aspects of technology capacity, three of which were included in this study: installed base, connectivity, and technical support.

What is the evidence that schools have adequate technology and connectivity?

The data suggest that adequate computers are available the region's schools, and that technology planners make maintaining and increasing this technology capacity a priority. Given the increasing student to new generation computer ratio that has been reported as a trend across the state (VISMT, 1999), this goal seems appropriate. The importance of this priority is seen in the observation of Becker (1998) that a high level of connectivity is the most important factor contributing to teachers' use of the Internet and

Dawson's (1998) observation that access is an important factor in elementary teachers' use of computers. Access has also been identified as the primary obstacle to instructional use of computers in a Rutland County middle school (Ackerman, 1997).

The data surrounding technology capacity in the region's schools is not complete, however. The respondents in this study made little specific mention of the technology capacity in their educational communities, although there was no specific inquiry about the adequacy or inadequacy of the available technology.

Further inquiry into technology capacity should focus on several areas. First, how does the extant technology capacity influence the learning of students and the development of professional competence of staff? This question needs to be asked from the perspective of what opportunities are available because of the existing technology capacity as well as the opportunities that are prevented by a lack of adequate technology capacity. Second, is the increasing student to computer ratios, which indicate decreasing relative technology capacity, influencing the nature of work in schools? This question also should be answered relative to student learning and teacher professional competence.

During the analysis of the data, a question arose concerning the accuracy of the data describing technology capacity as well. One respondent indicated that the data reported on the Vermont School Report for her school did not appear to include a significant technology purchase that arrived at the school in the weeks just prior to school opening for the 1999-2000 school year. In addition, a large computer purchase that was indicated by another respondent did not appear to have any influence on the student to computer ratios in the educational community. These two possible discrepancies in

reporting technology capacity illustrate the difficulty of accurately reporting accurate and current data in the quickly emerging field of educational technology.

What is the evidence that schools have adequate technical support?

From the descriptions of the responsibilities of technology support people, it becomes clear that many schools rely on knowledgeable teachers for the maintenance, troubleshooting, and repair of computer equipment. The same person who is the technology coordinator is likely to perform computer technician's duties, and frequently, will have classroom or librarian duties as well.

If initial troubleshooters are unable to make a repair, then a technician (or technology coordinator) is called. This sometimes becomes a "call and wait" process in many schools, with some schools compiling a list that awaits the technician's weekly visit to the school. Although knowledgeable teachers are always going to be called on by colleagues because of their accessibility, one must wonder how long this will be an effective way to address the technical installation, maintenance, troubleshooting and repair needs of schools. This question is especially important when considering the increasing quantity and complexity of the computers available in schools. The goals for the 1999-2000 school year summarized on Table 16, include schools increasing the number of computers and upgrading their existing equipment, several schools completing networking projects, and another school hoping to create a web site. These are all activities requiring high levels of expertise that are likely to further tax the time and push the knowledge of the "teaching troubleshooter" that is so common.

The relationship between the technician and the educators and the role of the technicians in the technology planing process appears to be important in promoting

successful use of computers. Several schools describe their technician, either part-time or full-time, as contributing members of their technology teams. Other schools appear to view their technicians as outside contractors; the technicians come in, make the repairs on a list and go on their way. Complaints about unresponsive technicians come from the schools with this relationship with their technicians.

A commitment to maintaining, troubleshooting and repairing the school's technology is important in promoting the successful use of computers. One of the technical centers in the region has developed a system of reporting and addressing the repair needs of the building such that down time is usually less than one day. The obvious question that arises when considering such a program is the budget that supports such a program.

Although defining a ratio for the number of computers needed per technician would be an appealing number to generate, the many variables that affect the performance of computers makes would make such a number misleading. Developing a better understanding of the nature of technical problems encountered in schools and a more detailed picture of the methods used by schools to fix these problems would be helpful.

Themes related to learning

Because only those participants who answered the survey for technology planning in individual schools were asked to describe how students use computers, the data provide only superficial evidence of the progress being made creating technology-rich learning environments. Despite these limits, the data do contain valuable insight into the

technology-based activities of students in the region's schools, and the data provide guidance for defining further research that will detail current progress in these essential Dimensions of technology planning. The analysis of this data is framed by the goals outlined in the ISTE Technology Standards and the Milken Exchange's Learner Dimension.

What is the evidence that students are becoming skilled computer users?

Helping students to become proficient users of computers and associated technologies is perhaps the most obvious or assumed goal of technology-rich education. Due to the constantly evolving nature of technology and the questionable nature of the definition of proficiency (see especially Stoll, 1999), defining proficiency is a challenge. It is reasonable to assume that students who use computers during their work will become proficient users, and it is equally reasonable to assume that providing students with opportunities to become proficient in the use of computers is a necessary goal of the modern curriculum.

Given the uses of computers by students in schools across the country that were described by Coley (1999), the number of respondents indicating that students in Bennington and Rutland Counties use computers for word processing is not surprising, indeed to have observed otherwise would have been unexpected. Other common uses of computers by students in the sampled schools are researching, especially Internet-based research, and creating multimedia presentations. Although the data provide little detail into the nature of the research and the content or purpose of the multimedia presentations, the mere mention of these activities does indicate progress is being made towards achieving the ISTE Technology Foundation Standards for All Students.

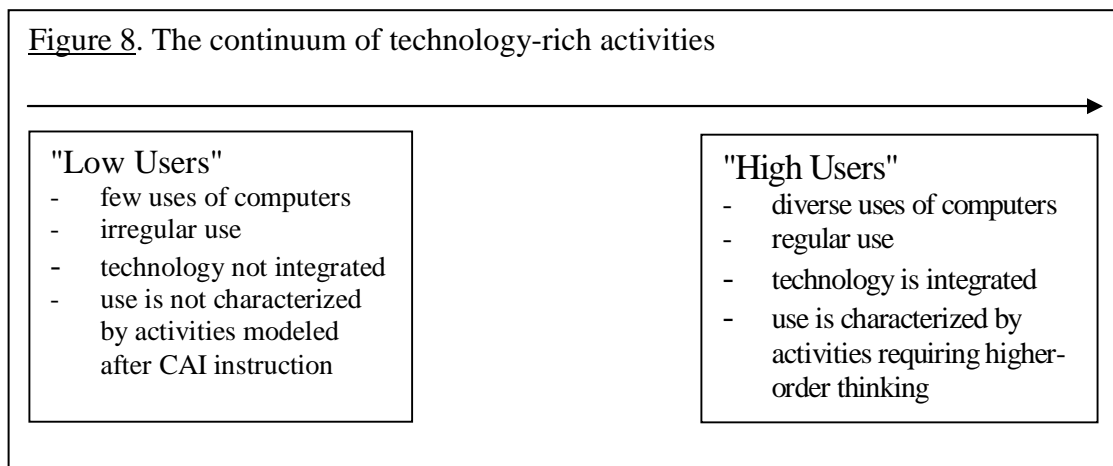
As students create multimedia presentations, they perform a variety of tasks using computers and other hardware that provide the opportunity to meet ISTE's Technology Foundation Standards for All Students. Typically, multimedia projects are similar in scope and content to the traditional reports assigned throughout students' school careers. The difference between traditional reports and multimedia presentation is in the media used to communicate the report and the nature of the software used to organize the information. Whereas authors of traditional reports communicate primarily through text with occasional graphic illustrations, authors of multimedia presentations communicate through a variety of media, including text, graphics, movies, sounds, and animations. As multimedia authors prepare their work, they use scanners and digital cameras to digitize pictures, image editing software to prepare pictures, hardware and software to record sounds, and even video capture capabilities on multimedia computers to capture video clips and images. Multimedia authors can choose from a number of software packages to compile their work. In general, all of those packages allow multimedia authors to insert and organize media in ways that, when well done, communicate their understanding of the topic in an effective manner and demonstrate technological acumen.

Using technology tools to gather data is another characteristic of proficient users of computers as defined by the ISTE Standards. Evidence that students in the region are being provided the opportunity to become capable computer users by gathering data using technology tools can be seen by the identification of computer-based research as a common technology-based activity in the sampled schools. What is not clear from the data, however, is if the technology-based research occurring in the sampled schools completely meets the ISTE standard which states "students use technology to locate,

evaluate, and collect information from a *variety* of sources" and "evaluate and select new information resources... based on the appropriateness to specific tasks" (emphasis added). (ISTE, 1999b)

Although the computer-based activities available to students in the region that are recorded in the data indicate the characteristics of proficient users are being addressed, there is little evidence that the current connections between the ISTE Standards and the computer-based curriculum in the region is the result of formal planning. Three respondents indicated that the school they were describing were considering formal technology curriculum development work, some of which is to be guided by the ISTE Standards, in the 1999-2000 school year.

The data also indicate a rich variety of other computer-based activities are available in the schools sampled, and the activities further encourage learning about the world through the use of technology. The diversity of technology-rich activities does not reach across all schools, however. The schools sampled fall along a continuum from those that offer relatively few meaningful technology activities to those that offer a variety of meaningful technology activities (see Figure 8).



On one end of the continuum are schools characterized by offering few technology-activities that provide students with few or no technology activities that allow students to develop the higher-order thinking skills that Schacter (1999) indicates are connected with improved student achievement in technology-rich environments. In the middle of the continuum, we find the region's schools in which the technology activities, generally, include word processing, computer-based and Internet-based research, and creating multimedia projects. At the other end of the continuum, we find schools that offer a diverse set of technology-based opportunities and activities for students and in this diverse set of technology-based opportunities there is evidence that the activities provide opportunities for students to use computers in higher-order thinking activities.

Educational Community #1 illustrates a school in the sample that falls on the High User end of the continuum. Data from this large high school indicate the educators in the school go to great lengths to plan for and implement the use of technology in all content areas. The respondent describes the bi-directional communication between teachers and technologist that occurs as plans are made for defining and purchasing the appropriate technology for the classrooms. The guidance given for the integration of technology into instruction by the long-range technology plan is also mentioned by the respondent and indicates diverse technology opportunities for students in the school. Unfortunately, the respondent mentioned, but did not elucidate, the details of the school's technology plan that specify how technology is integrated into instruction. Based on the limited data from this educational community, it appears that this school falls near the "creating meaningful technology-rich learning environments" end of the continuum.

Educational community #11 also illustrates the characteristics of a school on the High User end of the continuum. This K-12 school appears to be offering its students a breadth of technology activities. In addition to the word processing and multimedia authoring experiences that transcend the grades and content areas in the school, the curriculum includes technology-based activities within the humanities (the WEB Project and MIDI-based music activities), as well as specific technology activities in grade 5 history studies, and the application of technology to the authentic challenges of creating the yearbook.

Educational community #3 typifies a school that falls within the middle of the continuum. The two respondents who collaborated on a single survey describing this school indicate the students in the school use computers for word-processing, Internet-based research, and creating multimedia presentations, uses that were common in the data. The data from this school also indicates efforts are underway for the school to begin an assessment program in which students create an electronic portfolios. This school may well be progressing towards the High User end of the continuum. If further study were to show that the electronic portfolio program being undertaken in the school is consistent with the Constructivist vision proposed by Barrett (1999), then the program would certainly contribute to the school's progress towards providing meaningful technology-based experiences for its students. Technology-rich activities that are aligned with Constructivist principles move the school further towards the High User end of the continuum than activities which as review or skill building software, which is likely to be a vestige of the computer aided instruction (CAI) model of the early years of educational computing. Other educational communities in the middle of this continuum provide

additional technology activities for students as well. Spreadsheets, "educational games," and the use of skill building or review software are often mentioned as student uses of computers that join word processing and multimedia authoring in the technology programs of these schools.

One of the elementary schools in educational community #8 illustrates a school at the end of the spectrum characterized by schools providing few meaningful technology activities for the students. In that particular elementary school, the respondent indicated that students use the few available computers during free time or on a rotational basis. It is important to note that school has student to computer ratios that are among the highest reported for any of the schools sampled: the student to computer ratio is 8.7 which is in the 87th percentile for the state, and a students to new generation computer ratio of 58.5 which is in the 96th percentile. This low progress towards creating meaningful technology-based learning environments occurring in a school with such low technology capacity illustrates the interconnectedness of technology planning. Clearly this school does not have the technology capacity required for providing the technology-rich activities to allow students to develop in the ways Papert and others envision.

The need for more study of technology-based learning

Discretion must be exercised when reaching conclusions concerning schools' progress in creating student-centered technology-rich learning environments based on the limited data gathered for this study. Little can be concluded beyond the observation that the schools in the region fall along the previously described continuum. It should be noted that the schools cited as examples of various points along the continuum are used

to illustrate the continuum of progress that has emerged from the data-- data that was, typically, provided by only one respondent from each educational community.

To gain a more complete picture of the use of computers in the schools of the region, a number of studies are suggested by this study. A number of the studies are elucidated below, and potential research methodologies are suggested. These more complete studies will include multiple perspectives within each school and the studies will include a number of different sources of data that will contribute to a complete understanding of progress in creating student-centered technology-rich learning. This understanding will advise and guide future work in educational technology in the region.

What is the nature of the assignments guiding the multimedia authoring and Internet research that is so common in the region?

The data indicate a number of schools have students using technology for multimedia authoring activities and have students conducting computer-based research, but the details of these activities are missing. By analyzing the tasks directing the multimedia assignments and materials provided to support students in these activities, researchers could determine if, and to what extent, the activities have the characteristics of student-centered or Constructivist classrooms. Brooks and Brooks (1993) give twelve characteristics of Constructivist classrooms that could provide a framework for observing and understanding student-centered classrooms.

Valuable perspectives on the nature of the computer-based research and multimedia authoring occurring in schools could be obtained by gathering data from a number of stakeholders during future research. Teachers could provide insight into the philosophical or theoretical foundations of the work, the connection of the assignments to

the school's curriculum and the national standards, and the classroom context of the assignments. Librarians and library/ media specialists could provide insight into the challenges encountered during research on extant computers and networks and insight into the evaluation of resources that occurs during research. Students could provide insight into the meaning of the research and multimedia authoring activities within the context of their learning and school experiences.

What is the design of the formal information technology courses in the region's schools?

Some of the respondents described schools that offer a formal information technology course for students; the respondents who identified these programs were describing elementary schools and middle schools. Presumably, the region's high schools have formal information technology courses as well. Even in those educational communities that indicated information technology courses are included in the curriculum, there were respondents who indicated that the information technology curriculum was undergoing review in the 1999-2000 school year. This observation suggests that much of the information technology instruction is guided by informal curriculum guidelines, if it is guided at all, points out the need for research about instruction in information technology in the region.

A review of the curricular designs and pedagogical practices in information technology would determine the extent to which there is alignment with ISTE's Technology Foundation Standards for All Students, as well as the connection between the technology curricula and the other curricular goals of the school. The technology

curriculum analysis could also determine the focus of the goals and determine if attention paid to general skills or to specific software programs. As Vermont's Statewide Education Technology Plan is revised and the process of defining information technology standards proceeds, data on the current work in schools would be valuable, although it is unlikely that the current work can be documented before the state technology plan is rewritten.

When designing research to document current practice in information technology education, researchers have tools to aid their data collection. Engaged Learning, the model of effective technology-rich education described and measured by the Technology Effectiveness Framework (Jones et al., 1995), would be a useful instrument for those undertaking studies into technology-based learning. The twenty-six indicators of Engaged Learning which are measured by the data collection instrument in the Framework can assist researchers seeking to understand and measure the influence of these ideas on the practice in schools. Engaged Learning is a model that is repeated throughout the educational technology literature, although it is given different names. By whatever name used, Engaged Learning is clearly aligned with Constructivist learning theory and cognitive psychology, and that measuring Engaged Learning will indicate the extent to which the learning environment in a school is aligned with that envisioned by the authors of the Seven Dimensions and the ISTE Essential Conditions.

Themes related to professional competency

The schools of southwestern Vermont have a variety of formal and informal support systems for teachers who are using computers. The formal programs include numerous workshops and courses in the summer and after school that schools, district,

and supervisory unions sponsor for their teachers. The perceived importance of professional development throughout Bennington and Rutland Counties can be seen in the observation that providing professional development was the most frequently reported technology goal for the 1999-2000 school year reported on the surveys. Only five respondents indicated the nature of these workshops and courses, but all five indicated the courses are introductory level courses, intended to help teachers develop their own skills and knowledge as computer users. There is little mention of coursework intended to help teachers integrate computers into their teaching or develop technology management or evaluation skills. Other formal programs include the use of resources from outside the school such as VITA-Learn, colleges, and technical centers. These are not reported as a resource on a wide scale, however.

The data gathered for this study indicate that almost all of the sampled schools address professional development needs in their technology plans to some extent. In addition, many of the sampled schools actually provide the professional development workshops and courses that their teachers need. Technology coordinators who work in school buildings, as well as in whole districts or supervisory unions play an important role in organizing and providing this training, and principals play an important role in encouraging professional development. Although the data give insight into the activities sponsored by schools in the region that are designed to promote professional competency in educational technology, the data give little detail of teachers' skills with computers or teachers' use of computers in their professional learning.

The data provide little insight into the characteristics of meaningful professional development for teachers in the region. More specific information regarding the level of

instruction, models of delivery, and effectiveness of the formal workshops and courses would contribute to our understanding of this important aspect of technology planning. The nature of the opportunities offered by the outside agencies in the region would contribute to the understanding as well.

The data do detail some of the professional development opportunities in the schools, districts, and supervisory unions in Bennington and Rutland Counties. The nature of the courses offered at a local level varies to some extent with two of the large districts and supervisory unions offering what appears to be a large and diverse selection of opportunities. Educational community #2 specifies two tiers of training for the teachers in the supervisory union: introductory training, especially for teachers new to the supervisory union and second tier training, which focuses on the use of computers in classrooms, for those comfortable with the available technology. This two-tiered model is part of the on-going professional development program in the supervisory union. After school workshops and graduate level courses are included in the educational technology offerings in educational community #8. All of the respondents who described technology planning in that educational community mentioned the role of the district-sponsored sessions in their surveys, and one respondent praised the quality and flexibility of the individuals who provide that training. The nature of the training in this educational community could not be discerned from the data, however.

Another educational community that specified the nature of the school-sponsored technology training is educational community #7. After recognizing that some teachers are not confident using the technology currently available, the school has included

offering first tier training, which focuses on teachers' skill in operating computers, as a goal for the 1999-2000 school year.

A more detailed description of the current educational technology skills and knowledge of the region's teachers and a more detailed understanding of the nature of the courses and workshops sponsored by educational communities throughout the region will contribute to the understanding of technology planning and contribute to future plans. Further study in this area of technology planning will gather data on all levels of professional competency: core technical skill, the use of technology in teaching and assessment, and the use of technology in professional learning and professional practice. Two instruments will be useful to those technology planners and researchers attempting to gather this data: The Teaching with Technology Instrument (Atkins and Vasu, 1998) and the Professional Competency Continuum (Coughlin and Lemke, 1999).

Although designed specifically for teachers in North Carolina and hence containing references to specific initiatives in the state, the Teaching with Technology Instrument can provide insight into teachers' perceptions of their current skills and abilities to use computers and their perceptions of their current knowledge in using technology in their teaching. The authors of the Instrument suggest using it to guide the planning of staff development experiences that focus on the use of computers to provide instruction, the use of computers to support learner expression, and on locating and evaluating technology resources.

The Professional Competency Continuum is part of the Milken Exchange's ongoing efforts to define the Seven Dimensions for Gauging Progress. The profiles provided by the PCC provide a framework for understanding the progress that teachers

have made in a variety of skill areas including core technology skill; curriculum, learning and assessment; professional practice; classroom instruction and management; and administrative competencies. The three stages defined by the PCC: emergent, adaptation, and transformation allow teachers and technology leaders to understand the skills and the nature of the teachers interactions with kids and computers, understandings that will help define the need for professional development.

Themes related to decision-making

Technology planning is a decision-making process. Because of the complexity of the process, most of the survey questions focused on the organizations and processes of decision-making within the domain of educational technology. Among the important issues related to decision-making that emerged from the data are the work of technology committees, vision, leadership, and planning or decision-making practices that include existing technology plans.

How do technology committees contribute to technology planning?

Technology planners make decisions concerning what and how much technology will be made available, how computers will be used to benefit learning, how equipment will be maintained, and how teachers will be supported. The process takes on its own characteristics in each school community. Garmston and Wellman (1998) identify three roles for committees that are involved in these decisions: Dialoguing to develop understanding, discussing to recommend decisions, and making decisions.

Because of the implied responsibility, decision-making may appear to be the most important of Garmston and Wellman's activities, but those authors stress the importance

of all three of these activities to the process of defining and developing meaningful student learning. During dialogue and discussion, the beliefs about computers in schools are defined and developed. Schofield (1985) found the beliefs about the role of computers in the process of learning and beliefs about how teachers will use computers are more important than hardware and software purchasing decisions in influencing the use of computers in schools.

Given the importance of the work of these committees in defining the vision and developing the strategies of a school's technology program, it is reasonable to strive to make this an inclusive group. Indeed, the involvement of the community in developing and implementing technology plans is a goal stated repeatedly in the literature and the Vermont State Educational Technology Plan. Despite this goal, the technology committees of southwestern Vermont appear to lack diversity. Only four of the 17 committees described in the data have a membership that includes six or more stakeholders and 10 are composed exclusively of some combination of school employees, especially teachers, administrators, and technology coordinators.

Few conclusions can be drawn beyond the fact that the region's technology committees appear to not represent all stakeholders in the community. The data give no indication of efforts that have been made to include others in the work of these committees. The data give no indication of the awareness of the need for widespread participation on these committees among school officials or citizenry. The data give no indication of the resistance of lay people to participate in such school related activities. These are all factors that could potentially limit the diversity of members on technology

committees. The level and nature of administrators' involvement on technology committees is a topic that needs to be better understood.

What is the evidence for vision in technology planning?

The vision that guides the technology planning in a schools, districts and supervisory unions emerges from the fundamental beliefs about learners and cognitive tools held by the principle decision makers. This vision guides the work of these individuals, and through their leadership, it guides the work of all stakeholders involved in the technology planning. Schofield (1995) found the vision, which includes the assumptions, beliefs, policies, and theories upon which decisions are made, to be more important than the amount and type of hardware purchased in influencing the use of computers in schools. This vision plays a central role in technology planning and implementation. In order to influence change, the vision must remain foremost in the minds of those making the significant technology decisions, and this vision must be immediately defined and applied by the decision makers (Schwann and Spady, 1998).

The Seven Dimensions for Gauging Progress suggests that the creation of technology-rich student-centered learning environments occurs only through system-wide change and that change is guided by "a compelling vision and clear expectations for technology in schools" (p.24). Evidence of such visions is difficult to find in the data. An example of how vision can direct technology decisions in school comes from educational community #2. The respondent described his own experiences using computers to teach creative writing as influencing his thinking about computers in schools. He also described his supervisory union as committed to improving teaching through technology. He supported that claim by describing the situation of a social studies teacher who wanted to

increase her ability to use the Internet from her classroom. Because of her interest, and the school's vision to support technology-rich learning environments, the technology plan was modified to include an Internet hub in her classroom to allow for multiple connections to the Internet from her classroom.

The responses to two questions in particular were studied for evidence of the vision of computers in school that are guiding the work of the respondents. The first question of the two asked participants what or who had influenced their thinking about computers in schools. Analysis of the responses to this question was intended to help understand the personal visions of the individuals involved in technology planning. The second question of particular interest when analyzing for vision asked respondents what the school's goals relative to computers are for the 1999-2000 school year. The intent of this analysis was to understand the vision as embodied in the institution's goals.

Respondents identified a variety of influences on their thinking about computers and students. These experiences include previous teaching experiences, both with and without computers, work for graduate degrees, and interactions with colleagues. Other than the experience with creative writing that motivated the purchase of the network hub for a social studies teacher that was previously described, there is no evidence of respondents being "compelled" to decisions by their vision.

The absence of vision from the data could very well be a result any number of factors. First, the respondents may not have realized the importance of the information, so they focused little attention on their response. Second, the respondents could have decided to focus on the more practical aspects of their work and the more practical influences on their thinking. Third, the data could also record an actual absence of vision

from the thinking of the respondents. Finally, the lack of an important and immediately meaningful vision in the respondents' previous experience with technology planning in the region is a final explanation for the lack of evidence for compelling vision.

Further research into the personal visions of those involved in technology planning is clearly needed. In order to understand the visions of individuals involved in technology planning, in-depth phenomenological interviewing (Seidman, 1998) would be an effective methodology. Seidman's methods are intended to help researchers understand the previous experiences of participants and the meaning the participant make of those experiences. In these surveys, interactions with peers and colleagues, respondents own use of computers, participation in a variety of professional activities, and experiences in schools are noted as influencing respondents' thinking about computers in schools. Those involved with technology planning have broad and deep experiences which are influencing their work. Understanding the importance of those experiences to the technology planners will be an important step in understanding and creating future vision.

In addition to the personal visions of those involved in technology planning, the vision of the entire organization influences the work of developing and implementing technology plans. Although data do provide glimpses of "compelling" school wide visions of computers in schools (for example the two schools that have stated the goal of extending professional development opportunities to the community, and the school that stated a goal of addressing issues surrounding equitable access to computers in homes), the data have little to offer those seeking to understand the compelling visions driving technology planning in the sampled schools. The absence of evidence for these visions can be attributed to any of the reasons suggested for the similar lack of evidence of

personal vision. The same need to understand organizational visions exists as well. The inquiry into organizational visions could be relative to the visions included in the technology plans certified by the Vermont Department of Education.

What evidence is there for effective leadership?

School leaders have a key role in the development and implementation of technology plans. Although there was no question on either survey asking directly about the leaders in educational technology in the region's school, districts and supervisory unions, the characteristics of the leaders were identified in the responses. Strong leaders emerged as a characteristic of schools making progress towards the effective use of computers. Abbreviated profiles of some of these strong leaders are provided to illustrate the work of these individuals.

First, there is a technology teacher/ technology coordinator who is described as the "cheerleader for technology" in the school. This individual is responsible for the entire technology program in her small elementary school. She teaches computer classes and is the initial contact person in the school for technical assistance, including troubleshooting. Her responsibilities also include providing or arranging professional development, and technology budgeting and purchasing. This person is described as the leader in technology despite having "won some and lost some" when having decisions made according to her recommendations. This school is beginning a computer-based assessment program that will be a model for other schools in the region.

Second is a technology teacher who is the leader in the area of information technology in his school. Despite the existence of a technology coordinator and technician in his district, this person is seen as the best and most patient troubleshooter

and technology resource in the building, and is often called by those in other schools with professional development, curriculum, and technical questions.

Third is another technology teacher/ technology coordinator who teaches classes as well as serving as the first line of troubleshooting assistance in her school. She spends a good deal of time with the faculty in her school consulting on curriculum ideas as well as recommending hardware and software for teachers. She maintains a collaborative relationship with the technology coordinator for her district and the technician who is responsible for her school on a part-time basis.

Finally, there is a principal in a small school who views technology planning as a collaborative process. This principal works in a school with a diverse technology committee and a part time technology coordinator who works as the technician as well. In this school, students use computers for a variety of activities, which are examples of integrating computers into learning activities. She is viewed as an active supporter of teachers' efforts to include technology-based activities in their classes.

One common theme that occurs in the descriptions of these leaders is their efforts to assist teachers who are increasing their use of computers in their classes. Lily (1999) refers to these people who facilitate the use of technology as "Tech Coaches." These are the individuals who help merge the education culture with the technology culture (Zhao et al., 1998).

The influence that the building-based leaders mentioned in the brief profiles above is considerable. The role of these technology integrators to the successful use of computers in schools is an aspect of technology planning that deserves more study. What makes the current leaders so effective? What are their personal and professional

characteristics that make them worthy of mention to those completing these surveys?
What is the nature of their interactions with their students, colleagues, and superiors?

Considering the importance of building-level administrators (MacNeil and Dellafield, 1998) and central office administrators (Hunt and Lockhart, 1998) in influencing the school culture and effectiveness of work in schools, the relative absence of those individuals from the leaders mentioned in the surveys is puzzling. Only two principals were mentioned as having taken a role in the technology planning process. One is described above and the other was a principal who reported herself as an "advocate for technology," but did not provide specific examples of her advocacy. No other building administrators or central office administrators are mentioned as strong leaders in educational technology.

Few conclusions can be drawn from the relative absence of administrators and technology coordinators, however. Many explanations for the lack of administrators in the data occur. First, looking again at the survey questions, this question must be raised: If the surveys asked specifically about the role of the principal or superintendent in the technology planning process, would their roles have been recorded in the data? The only specific reference to administrators on the surveys asked if administrators served on technology committees, perhaps different questions would have provided more data in this area.

Second, respondents could have viewed the survey as a way to publicly recognize the work of those who work for technology in their schools. This could have caused respondents to use the survey as a forum to heap well deserved praise on the teacher leaders.

Third, the strength of the teacher leaders could represent a redistribution of power within the education community, at least in the area of educational technology. Lambert (1999) suggests the meaningful implementation of technology plans, and other school initiative, requires high levels of leadership capacity, which is characterized by a redistribution of power, a culture of inquiry, and inclusive governance. Delegating leadership in educational technology to those involved with children on a daily basis is probably a wise decision, as pedagogy, especially constructivist pedagogy, is linked to increased and effective use of computers in schools (Becker, 1999; Papert, 1993).

Finally, the absence of administrators from the list of strong leaders could indicate a decision by the administrators to focus on other aspects of school administration because of lack of interest in or knowledge about educational technology or because of other demands of time and attention. Goldman (1998) suggests a school's culture reflects the beliefs of the leaders. Applying this principle to the current data raises the question: Do area administrators value technology as a viable medium in their schools?

Clearly, further study is needed to understand the role of the administrators who are absent from the data. This study should inquire into the roles of assistant principals and other building-wide administrators, curriculum directors, assistant superintendents, and superintendents in the technology planning process.

The influence of funding on decision-making.

Another theme that emerged as influencing technology planning in one school is financial support. Funding for educational technology in Vermont schools comes from a variety of sources including local funds, e-rate discounts, grants, and outside organizations (such as VITA-Learn). One school identified the availability of funds as

influencing technology purchase decisions in the school. With no question focusing on the finances of educational technology on the surveys, this aspect of technology planning was uninvestigated. Understanding the sources of funds used by the schools, districts, and supervisory unions in the region, as well as the relative importance of each funding sources would be important in understanding the technology planning in the region.

What is the evidence that extant technology plans are influencing the work of technology planners?

In order to be eligible for several important grant programs, including Technology Literacy Challenge Grants and E-rate discounts, schools in Vermont must have a technology plan that is certified by the Vermont Department of Education. Respondents from five schools described the influence of these plans on activities in the school. Two different types of technology plans are described in the data: plans that focus on, or at least include to a large degree, plans for curriculum, instruction and professional development and plans that focus in large part on technology acquisition or increasing technology capacity.

The technology plans that address needs beyond building technology capacity guide a dynamic decision-making process. Teachers and technologists in these schools have a bi-directional recommendation process: Teachers talk about their needs and the technologist makes hardware and software recommendations based on these needs, and the technologist talks about new hardware and software that may be useful to the teachers. This dialogue occurs within a context defined by the departmental curriculum plans and the technology plan of the school.

The second type of plan focuses almost exclusively on technology acquisition, or appears to focus exclusively on hardware acquisition as the only mention of the plan was in this way. In general, these references lacked the positive tone that characterized the plans described above. Whereas the other type of plan seemed to set the context for decision-making, this type of plan is seen as containing the decisions. If further data confirmed this conclusion about the role, or perceived role, of these plans, then that is a source of concern.

Data gathering in schools

There is little evidence that schools have formal methods in place for gathering data relative to educational technology. Considering the need for work in this area as described by the Annenberg Institute for School Reform (1998), the relative absence of data in this area is perhaps not unexpected.

The surveys did gather data describing the methods schools in the region currently use to gather data about technology in their schools. The methods currently used are primarily informal, with observations and talking with others being among the most frequently identified methods. Surveys were the only method that seems to be both common and probably formal. The details of how these surveys are administered or what they measure were not clear in the data, however. One school did mention that a goal for the 1999-2000 school year was to complete the "Staff Needs Assessment Survey" and plan professional development according to the results. As schools begin to develop standards-based curricula and professional development programs, it is likely that technology planners will develop assessment plans based on the standards and using the published assessment tools.

The integration of technology into the work of the school

The literature in educational technology is rich with reference to a seldom-defined process: "the integration of technology into school work." The data describe several situations that illustrate how technology planners use technology in order to accomplish necessary tasks in their professional work. When gathering data to guide their work, the technology planners in one school review teachers' Individual Professional Development Plans; the elegance of this solution to the problem of understanding teachers' needs is so obvious when it is pointed out in this data. The same school provides the next example of the integration of technology into meaningful work in the school: The first line of troubleshooting help for teachers in this high school is a student-run technical help desk. In this example, we see authentic learning activities for students, and the learning activity providing a valuable service to the community.

Another example of using technology to do the work of the technologist comes from a large supervisory union that employs a technology coordinator and multiple computer technicians. Upon finding a broken computer, teachers inform the technology coordinator in writing. The technology coordinator then uses the supervisory union web page to inform the technicians and coordinate their schedules.

A third example of the integration of technology into a school's work comes from a small elementary school. This school addresses professional development and support issues in educational technology through the teacher leader program that exists in the school. Through this venue, teachers are provided support in a way that connects technology with other teacher improvement efforts.

Understanding the use of computers and related technologies in the work of developing and implementing technology plans is an intriguing aspect of this work that deserves more inquiry. Now that the importance has been pointed out by the respondents in this project, observing this facet of technology planners work seems so obvious a window into their thinking about technology and their thinking about the importance of technology in their own work.

What is the evidence of collaboration with outside organizations?

A limited number of respondents indicated their school collaborates with outside organizations as part of their educational technology work. In particular, collaboration with the Vermont Information Technology Association for the Advancement of Learning to support professional development was mentioned as a valuable interaction.

Using web-based surveys

The web-based survey used in this project was developed after the survey had been developed and diskette-based and email-based versions had been sent to and completed by several volunteers. These individuals reported some problems, especially with the diskette version. When asked to reflect on the process and then talk about it, two of the initial users asked if a web-based version could be made available.

In general, the creation of the surveys was similar to that of a paper survey. The posting on the Internet took less time and money than copying would have. Several problems did arise, however. First, a programming problem caused the data on the number of technology coordinators and technicians to be unreliable. This problem was

difficult to realize until the data began to be recorded, and problems seemed to be exacerbate when participants reported both technology coordinators and technicians.

The ability to contact participants via email was vital to the success of this project. Contacting technologists via email appears to be gaining acceptance within the community of technologically savvy educators. The response rate was far better with email than with mail.

Three respondents reported problems with completing the surveys: One could not complete the survey for several weeks as the email server in his school was down. Two others reported the linked text in my email messages to them did not work. Persistence apparently paid off, however, as both individuals submitted surveys via the web site before I could offer alternative methods of completing the survey.

Discussion of importance

The current study is of interest to a variety of stakeholders in the regional educational community. I consider the particular interests of the various stakeholders from increasingly widening spheres of influence, from individual classrooms to the regional leaders in educational technology.

Those who are responsible for integrating technology into individual classrooms or projects, such as teachers, para-educators, and librarians or library media specialists, will have particular interest in the data and analysis that describes how students are using computers in the region's schools.

Those who are responsible for technology planning in school building, such as principals and other administrators and technology committee members will have particular interest in the data and analysis that describes decision-making.

Those who are responsible for technology planning within school districts or supervisory unions, such as central office administrators and technology coordinators will have particular interest in the data and analysis that describes decision-making and the data and analysis that describes professional development.

Those who are responsible for technology planning at a regional level, such as leaders in VITA-Learn, VISMT, and the region's colleges will have interest in all of the data and analyses.

Suggestions for further study

A number of unanswered questions arise from this study, and those have been elucidated in the Analysis section. The following list of questions identifies those questions without detail:

- 1) What is the influence of the existing technology on the learning of students and on the professional development of teachers?
- 2) Is the student to computer ratios in the region changing? If so, how is this influencing student work?
- 3) What is the actual current technology capacity of the schools in the region?
- 4) What is the nature and scope of the problems requiring technical assistance encountered on a regular basis?

- 5) How effective is the teacher/ technician model of addressing technical support?
- 6) What are the approximate costs of establishing and maintaining technology capacity in Bennington and Rutland Counties?
- 7) What is the nature of the technology-based work assigned to students?
(including: Internet-based research, multi-media research, and the formal information technology classes)
- 8) What is the nature and scope of the professional development opportunities offered by school in the region?
- 9) How does technology influence the administration and operation of the schools?
- 10) What are the characteristics of the technology leaders in the region?
- 11) How does funding influence technology planning in the region?
- 12) How are technology plans updated and how do those documents influence technology planning?
- 13) What are the ways that technology has been integrated into the operations of schools in the region?
- 14) What is the nature and extent of the collaborative relationships between schools and other organizations?

References

Ackerman, G. (1997). Interviewing to Understand Technology. Unpublished manuscript, Castleton State College.

Anderson, L. (1996). K-12 Technology Planning at State, District, and Local Levels. Syracuse, NY: Education Resources Information Center. (EDO-IR-96-07) Retrieved October 5, 1999 from the World Wide Web: <http://ericir.syr.edu/ithome/digests/k-12technology.html>.

Anderson, L. (1999). Technology Planning: It's More Than Computers. Mississippi State, MI: National Center for Technology Planning. Retrieved October 5, 1999 from the World Wide Web: <http://www.nctp.com/articles/tpmore.pdf>

Anderson, L. and J. Perry. (1994). Technology Planning: A Recipe for Success. Mississippi State, MI: National Center for Technology Planning. Retrieved June 5, 1999 from the World Wide Web: <http://www.nctp.com/tp.recipe.html>

Anderson, R. and Ronnvist, A.. (1999). The Presence of Computers in American Schools. The University of California, Irvine and The University of Minnesota: Center for Research on Information Technology and Organizations. Retrieved October 1, 1999 from World Wide Web: <http://www.citro.uci.edu/TLC/findings/Internet-Use/startpage.htm>

Annenberg Institute for School Reform. (1998). Using Data for School Improvement: Report on the Second Practitioners' Conference for Annenberg Challenge Sites. Providence RI: Annenberg Institute for School Reform. Retrieved November 12, 1999 from the World Wide Web: http://www.aisr.brown.edu/images/using_data4.pdf

Annenberg Institute for School Reform. (1999). What is the Tools for Accountability Project? Providence RI: Annenberg Institute for School Reform .

Retrieved December 3, 1999 form the World Wide Web:

<http://www.aisr.brown.edu/html/tools/overview.html>

Annenberg Institute for School Reform. (1999b). A Framework for Accountability. Providence RI: Annenberg Institute for School Reform . Retrieved

December 3, 1999 form the World Wide Web:

<http://www.aisr.brown.edu/html/tools/framework/pgfour.html>, December 3, 1999.

Atkins, N. and E. Vasu. (1998). The Teaching with Technology Instrument. Learning and Leading with Technology, 25 (8), 35-39.

Bailey, G. (1997). What Technology Leaders Need to Know: The Essential Top 10 Concepts for Technology Integration in the 21st Century. Learning and Leading with Technology, 25 (1), 57-62.

Barker, B. and Hall, R. (1998). Planning for Technology Implementation in Rural Schools. Rural Education, 19 (3), 1-6.

Barrett, H. (1998). Strategic Questions: What to consider when planning for electronic portfolios. Learning and Leading with Technology, 26 (2). Retrieved November 22, 1999 from the World Wide Web:

<http://www.iste.org/L&L/archive/vol26/no2/feature/index.html>

Bauder, D., Carr, D., Mullick, R. & Sarner, R. (1997). Making Research Count: Some Guideline fir Researchers. In S. McNeil, J. Price, S.B. Mehall, B. Robin, & J. Willis (Eds.), Society for Information Technology & Teacher Education '98. Association for the Advancement of Computing in Education. Retrieved June 8, 1999 from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1997/re_baud.htm

Becker, H. (1999). Internet Use by Teachers: Conditions for Professional Use and Teacher-Directed Student Use. The University of California, Irvine and The University of Minnesota: Center for Research on Information Technology and Organizations. Retrieved October 1, 1999 from the World Wide Web: <http://www.citro.uci.edu/TLC/findings/Internet-Use/startpage.htm>

Bennett, F. (1996). Computers as Tutors: Solving the Crisis in Education. Retrieved October 4, 1999 from World Wide Web: <http://www.cris.com/~Fablen1/>

Boethel, Martha; K. Victoria Dimock and Lin Hatch. (1998). Putting Technology into the Classroom: A Guide for Rural Decision Makers. Austin, TX: Southwest Educational Development Laboratory. Retrieved October 5, 1999 from World Wide Web: <http://www.sedl.org/tap/puttech.pdf>

Bray, B. (1999). Eight Steps to Success: Technology Staff Development that Works. Learning and Leading with Technology, 27 (3). Retrieved November 22, 1999 from World Wide Web: <http://www.iste.org/L&L/archive/vol27/no3/features/bray/index.html>

Brooks, J. G. and M. G. Brooks. (1993). In Search of Understanding: The Case for the Constructivist Classroom. Alexandria, Virginia: Association for Curriculum and Development.

Byrom, E. (1998). Factors Influencing the Effective Use of Technology for Teaching and Learning. Greensboro, NC: Southeast and Island Regional Technology in Education Consortium. Retrieved October 14, 1999 from the World Wide Web: <http://www.serve.org/seir-tec/publications/lessons.html>

Carr, A., D. Jonassen, M. Litzinger, and R. Marra. (1998). Good ideas to foment educational revolution: The role of systematic change in advancing situated learning, constructivism, and feminist pedagogy. Educational Technology, 38 (1), 5-15.

CEO Forum. (1999). StaR Chart. Retrieved December 3, 1999 from the World Wide Web: <http://www.ceoforum.org/questions.html>

Charp, S. (1999). Improving Teacher Preparation for the Use of Technology. Technical Horizons in Education Journal 26 (8). Retrieved November 12, 1999 from the World Wide Web: <http://www.thejournal.com/magazine/vault/A2097.cfm>

Clements, D.. (1986). Effects of LOGO and CAI Environments on Cognition and Creativity. Journal of Educational Psychology, 78(4), 309-18.

Coley, R. (1999). Computers and Classrooms: The Status of Technology in U.S. Schools. Princeton, NJ: Educational Testing Service. Retrieved June 3, 1999 from the World Wide Web: <http://www.ets.org/research/pic/compclass.html>

Comley, P. (1996). The Use of the Internet as a Data Collection Method. Simon Godfrey Associates. Retrieved October 5, 1999 from the World Wide Web: <http://www.sga.co.uk/esomar.html>

Connell, M. (1998). Technology in Constructivist Mathematics Classrooms. Journal of Computers in Mathematics and Science Teaching, 17 (4), 311-338.

Coughlin, E. (1999). Professional Competencies for the Digital Age Classroom. Learning and Leading with Technology, 27 (3). Retrieved November 22, 1999 from the World Wide Web: <http://www.iste.org/L&L/archive/vol27/no3/featrues/coughlin/index.html>

Coughlin, E. and Lemke, C. (1999). Professional Competency Continuum: Professional Skills for the Digital Classroom. Santa Monica, CA: Milken Exchange. Retrieved December 1, 1999 from the World Wide Web: <http://www.milkenexchange.org/projects/pcc/ME159.pdf>

Cradler, J. (1996). Implementing Technology in Education: Recent Findings from Research and Evaluation Methods. San Francisco, CA: Far West Laboratory. Retrieved November 15, 1999 from the World Wide Web: <http://www.fwl.org/techpolicy/recapproach.html>

Cropley, A. J.; Gross, P. F. (1973). Computer-Assisted Instruction and Increased Educational Productivity. Journal of Educational Administration, 11 (1), 115-123.

Dawson, K. (1998). Factors Influencing Elementary Teachers' Instructional Computer Use. In S. McNeil, J. Price, S.B. Mehall, B. Robin, & J. Willis (Eds.), Society for Information Technology & Teacher Education '98. Association for the Advancement of Computing in Education. Retrieved October 8, 1999 from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1998/re_daws.htm

Dede, C. (1997). Rethinking How to Invest in Technology. Educational Leadership, 55 (3), 12-16.

Duffy, T. & Cunningham, D. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen, (Ed.), Handbook of Research for Educational Communications and Technology. (pp. 170-198) New York, NY: Simon & Schuster Macmillian.

EDmin.com (1999). Technology Planning: Technology Maturity Model. San Diego, CA: Edmin.com. Retrieved December 3, 1999 from the World Wide Web: <http://www.edmin.com/tp/tmm.html>

Education and Libraries Networks Coalition. (1999). E-rate: Connecting Kids and Communities to the Future. Education and Libraries Networks Coalition. Retrieved November 12, 1999 from the World Wide Web: <http://www.edlinc.org/pubs/eratereport.html>

Ely, D. (1999). New Perspectives on the Implementation of Educational Technology Innovations. Syracuse, NY: Education Resources Information Center. (ERIC Document Reproduction No. ED 427 775)

Fenstermacher, G. (1997). On Narrative. Teaching and Teacher Education, 13 (1), 119-124.

Fitzgerald, S. (1999). Technology's Real Costs: Protect Your Real Costs with Total Cost of Ownership. Electronic-School (September 1999). Retrieved November 12, 1999 from the World Wide Web: <http://www.electronic-school.com/199909/0999sbot.html>, November 12, 1999.

Fries, B. and B. Monahan. (1998). School District Technology Planning in an Era of Rapid Change. Educational Technology, 38 (1), 60-62.

Fullan, M. (1998). Leadership for the 21st century: Breaking the Bonds of Dependency. Educational Leadership, 55 (7). Retrieved November 12, 1999 from the World Wide Web: <http://www.ascd.org/pubs/el/april98/extfulle.htm>

Galas, C. (1998) . From Presentation to Programming: Doing Something Different, Not the Same Thing Differently. Learning and Leading with Technology, 25 (4),18-21.

Galas, C. (1999). The Never-Ending Story: Questioning Strategies for the Information Age. Learning and Leading with Technology ,26 (7), Retrieved November 22, 1999 from the World Wide Web: <http://www.iste.org/L&L/archive/vol26/no7/features/galas/index.html>

Galloway, J. and Blohm, P. (1997). Planning for Technology in the 21st Century: Perspective. Knowledge, Commitment and Process. In J. Willis, J. Rice, B. Robin, S. McNeil, D.A. Willis (Eds.), Technology and Teacher Education Annual. Association for the Advancement of Computing in Education. Retrieved October 8, 1999 from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1997/ec_gall.htm

Garbinger, R. S. (1996) Rich Environments for Active Research. In D. Jonassen (1996). Handbook of Research for educational communications and technology (pp. 665-692). New York, NY: Simon & Schuster Macmillian.

Garmston, R. and Wellman, B. (1998). Teacher Talk That Makes a Difference. Educational Leadership, 55 (7), 30-34.

Goldman,E. (1998). The Significance of Leadership Style. Educational Leadership, 55 (7), 20-22.

Graduate Students at Mississippi State University. (1996). Guidebook for Developing an Effective Instructional Technology Plan (version2.0). Mississippi State, MI: Mississippi State University. Retrieved October 5, 1999 from the World Wide Web: <http://www2.msstate.edu/~lsa1/nctp/guide.html>

Gooden, A. and F. Silverman. (1996). Computers in the Classroom: How Teachers and Students are Using Technology to Transform Learning. San Francisco, CA: Jossey-Bass: Apple Press.

Greening, T. (1998). Building the Constructivist Toolbox: An Exploration of Cognitive Technologies. Educational Technology, 38 (2), 23-35.

Harlow, S., and Johnson, D. L.. (1998). An Epistemology of Technology. Educational Technology Review, 37 (5), 47-50.

Hoepfl, M. (1997). Choosing Qualitative Research: A Primer for Technology Education Researchers. Journal of Technology Education, 9 (1). Retrieved October 1, 1999 from the World Wide Web: <http://scholar.lib.vt.edu/ejournals/JTE/v9n1/hoepfl.html>

Hunt, J. and J. Lockhard. (1998). How do School Districts Formulate Educational Technology Policy? Education Resources Information Center. (ERIC Document Reproduction No. ED 423 840)

International Society for Technology in Education. (1999). The National Educational Technology Standards Project. Eugene, OR: ISTE. Retrieved November 29, 1999 from World Wide Web: <http://www.cnets.iste.org/overview.html>

International Society for Technology in Education. (1999b). National Educational Technology Standards for Students. Eugene, OR: ISTE. Retrieved November 29, 1999 from World Wide Web: <http://cnets.iste.org/>, November 22, 1999.

International Society for Technology in Education. (1999c). National Educational Technology Standards for Students—Connecting Curriculum and Technology. Washington DC: ISTE.

International Society for Technology in Education. (1999d). Essential Conditions to Make it Happen. Eugene, OR: ISTE. Retrieved January 3, 2000 from the World Wide Web: <http://cnets.iste.org/condition.html>

International Society for Technology in Education. (1999e). ISTE Recommended Foundations in Technology for All Teachers. Eugene, OR, ISTE. Retrieved November 29, 1999 from the World Wide Web: <http://iste.org/Standards/NCATE/found.html>

Jerman, M. (1970). Computers, Instruction and the Curriculum. Educational Technology, 10 (5), 53-56.

Jervinen, E. (1998). The Lego/Logo Learning Environment in Technology Education: An Experiment in a Finnish Context. Journal of Technology Education, 9 (2).

Retrieved November 19, 1999 from the World Wide Web:

<http://scholar.lib.vt.edu/ejournals/JTE/v9n2/jrvinen.html>

Johnson, M., R. Schwab, and L. Foa. (1999). Technology as a Change Agent for the Teaching Process. Theory into Practice, 38 (1), 24-31.

Jonassen, D. and T. Reeves (1996). Learning with Technology: Using Computers as Cognitive Tools. In Jonassen, D. (Ed.). (1996). Handbook of Research for educational communications and technology. (pp. 693-719) New York, NY: Simon & Schuster Macmillian.

Jones, B., G. Valdez, J. Nowkowski, and C. Rasmussen. (1995). Plugging In: Choosing and Using Educational Technology. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved November 14, 1999 from the World Wide Web:

<http://www.ncrel.org/sdrs/edtalk/intro/pdf>

Kearsley, G. (1998). Educational Technology: a Critique. Educational Technology, 38 (2), 47-51.

Koschmann, T.D.; Myers, A.; Peltovish, P., and Barrows, B.. (1994). Using Technology to Assist in Realizing Effective Learning and Instruction: A Principled Approach to the Use of Computers in Collaborative Learning. Journal of Learning Science, 3 (3), 227-264.

Lambert, L. (1999). How to Build Leadership Capacity. Educational Leadership 55 (7), 17-19.

Lemke, C. and Coughlin, E.. (1998). Technology in American Schools: Seven Dimensions for Gauging Progress. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 10, 1999 from World Wide Web:
<http://www.milkenexchange.org/projects/7dim/ME158.pdf>

Lily, G. (1999). Tech Coaches: A Game Plan for Technology Support. Electronic-School (January 1999). Retrieved November 12, 1999 from World Wide Web:
<http://www.electronic-school.com/199901/0199f3.html>

Lord, T. (1998). Cooperative Learning That Really Works in Biology Teaching: Using Constructivist-Based Activities to Challenge Student Teams. American Biology Teacher, 60 (8), 580-588.

MacNeil, A.and Delafield, D. (1998). Principal Leadership for Successful School Technology Implementation. In S. McNeil, J. Price, S.B. Mehall, B. Robin, & J. Willis (Eds.), Society for Information Technology & Teacher Education '98. Association for the Advancement of Computing in Education. Retrieved October 8, 1999 from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1998/el_mac1.htm

Market Data Retrieval. (1998). 1998 Technology Findings in Public, Private, and Catholic Schools. Shelton, CT: Market Data Retrieval. Retrieved October 14, 1999 from the World Wide Web: <http://www.schooldata.com/datapoint26.html>

Maurer, M. and G. Davidson. (1999). Technology, Children, and the Power of the Heart. Phi Delta Kappan Online Article. Retrieved November 12, 1999 from the World Wide Web: <http://www.pdkintl.org/kappan/kman9902.html>

McLellan, H. (1998). Virtual Events: A Cyberspace Resource for Teachers. Educational Technology 38 (2), 57-61.

McNabb, M.; Valdez, G., Nowakowski, J., & Hawkes, M.. (1999). Technology Connections for School Improvement: Planners' Handbook. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved September 30, 1999 from the World Wide Web: <http://www.ncrel.org/tplan/handbook.pdf>

McNabb, M. (1999). Technology Connections for School Improvement: Teacher's Guide Handbook. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved September 30, 1999 from the World Wide Web: <http://www.ncrel.org/tplan/tplanB.htm>.

Mickelwait, J. and Wooldridge, A. (1996). The Witch Doctors: Making Sense of Management Gurus. New York: Time Book, Random House.

Middleton, J., Flores, A. & Knaupp, J. (1997). Shopping for Technology. Educational Leadership, 55 (3). Retrieved November 12, 1999 from the World Wide Web: <http://www.ascd.org/pubs/el/nov97/extmiddl.html>

Milken Exchange. (1999). Discrepancy Analysis Tool Prototype. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved December 3, 1999 from the World Wide Web: <http://www.milkenexchange.org/discrepence.taf?page=intrpo&session=>

Milken Exchange on Education Technology and Peter D. Hart Research Associates. (1997). Public Opinion Poll - 1998. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 23, 1999 from the World Wide Web: http://milkenexchange.org/publication.taf? function=detail&Content_uid1=99

Milken Exchange on Education Technology and Peter D. Hart Research Associates. (1998). Public Opinion Poll - 1998. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 23, 1999 from the World Wide Web: http://milkenexchange.org/publication.taf? function=detail&Content_uid1=162

Milken Exchange on Education Technology and Peter D. Hart Research Associates. (1999). Focus on Students: Teens Speak Out About Technology in Schools. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 23, 1999: http://www.milkenexchange.org/publication.taf?function=detail&Content_uid=165

Mintzberg, H. (1994). The Rise and Fall of Strategic Planning. New York: Free Press.

Monke, L. (1998) The Costs of Computers in Schools: Paying More than Dollars. Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 6. Retrieved November 10, 1999 from the World Wide Web: <http://jan.ucc.nau.edu/~icpt-j/1998/n1-2/monke.html>

Moursund, D., Bielefeldt, T., Underwood, S., & Underwood, D. (1998). The Road Ahead: Project Evaluation 1995-1997. Washington, DC: National Foundation for the Improvement of Education. Retrieved February 10, 2000 from the World Wide Web: <http://www.nfie.org/ra/eval/>

Moursund, D. and T. Bielefeldt. (1999). Will Teachers be Prepared to Teach in a Digital Age?: A National Survey of Technology in Teacher Education. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 12, from the World Wide Web: <http://www.milkenexchange.org/projects/iste/ME154.pdf>

National Center for Education Statistics. (1997). Technology @ Your Fingertips: A Guide to Implementing Technology Solutions for Education Agencies and Institutions. U.S. Department of Education: Washington, DC. Retrieved November 14, 1999 from the World Wide Web: <http://nces.ed.gov/pub98/98293.pdf>.

National Center for Education Statistics. (1999). Internet Access in Public Schools and Classrooms: 1994-1998. U.S. Department of Education: Washington, DC. Retrieved November 12, from the World Wide Web: <http://nces.ed.gov/pubs99/1999017.html>

National Study of School Evaluation. (1999). Technology: Indicators of Quality Information Technology Systems in K-12 Schools. Washington, DC: National Study of School Evaluation.

Niemiec, R.; Walberg, H. (1987). Comparative Effects of Computer-Assisted Instruction: A Synthesis of Reviews. Journal of Educational Computing Research, 3 (1), 19-37.

Norman, M. (1999). Beyond Hardware. American School Board Journal (July, 1999) Retrieved November 12, 1999 from the World Wide Web: <http://www.asbj.com/199907/0799coverstory.html>

North Central Regional Educational Laboratory. (1997). Handbook of Engaged Learning Projects. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved November 10, 1999 from the World Wide We

North Central Regional Educational Laboratory. (1999). Learning Through Technology: A Planning and Implementation Guide. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved November 15, 1999 from the World Wide Web: <http://www.ncrel.org/tandl/homepg.htm>

North Central Regional Educational Laboratory. (1999b). Guiding Questions for Technology Planning. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved November 15, 1999 from the World Wide Web: <http://www.ncrtec.org/capacity/guidewww/gqhome.htm>

North Central Regional Educational Laboratory. (1999). Learning with Technology Profile Tool. Oak Brook, IL: North Central Regional Educational Laboratory. Retrieved December 3, 1999 from the World Wide Web: <http://www.ncrtec.org/capacity/profile/prowww.htm>

Office of Educational Research and Improvement. (1998). An Educator's Guide to Evaluating the Use of Technology in Schools and Classrooms. Washington, DC: U.S. Department of Education. Retrieved November 1, 1999 from the World Wide Web: <http://www.ed.gov/PDFDOcs/handbook2.pdf>

Office of Technology Assessment. (1988). Power On! New Tools for Teaching and Learning. Washington, D.C: U.S. Government Printing Office. Retrieved January 4, 2000 from the World Wide Web: http://www.wws.princeton.edu/~ota/disk2/1988/8831_n.html

Office of Technology Assessment. (1995). Teacher and Technology: Making the Connection. Washington, DC: U.S. Government Printing Office. Retrieved October 14, 1999 from the World Wide Web: <http://www.princeton.edu/~ota/dist1/1995/9541.html>

Papert, S. (1972). Teaching Children to be Mathematicians Versus Teaching About Mathematics. International Journal of Mathematics Education, 3 (3), 249-262.

Papert, S. (1980). Mindstorms: Children, Computers, and Powerful Ideas. New York: Basic Books.

Papert, S. (1981). Computers and Computer Cultures. Creative Computing, 7 (3), 82-92.

Papert, S. (1993). The Children's Machine. Basic Books: New York.

Papert, S. (1996). The Connected Family- Bridging the Digital Generation Gap. Atlanta, GA: Longstreet Press.

- Patton, M.Q. (1990). Qualitative Evaluation and Research Methods (2nd ed.)
Newbury Park, CA: Sage Publications, Inc.
- Riedl, R.; T. Smith; A. Ware; A. Wark; P. Yount. (1998). Leadership for a
Technology-Rich Educational Environment. In S. McNeil, J. Price, S.B. Mehall, B.
Robin, & J. Willis (Eds.), Society for Information Technology & Teacher Education '98.
Association for the Advancement of Computing in Education. Retrieved October 8, 1999
from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1998/el_ried.htm
- Rita, R. (1998). Integrated Constructivism. Science Teacher, 65 (5), 24-27.
- Ritchie, D. and K. Boyle. (1998). Finding the Bucks for Technology. Learning
and Leading with Technology, 26 (2), 46-59.
- Rockman, Saul. (1998). Leader's Guide to Education Technology. Alexandria,
VA: EDvancenet. Retrieved November 12, 1999 from the World Wide Web:
http://www.edvancenet.org/res_guide_pdf.shtml
- Rogan, J. (1997). Online Mentoring: Reflections and Suggestions. Journal of
Computing in Teacher Education, 13 (3), 5-13.
- Rogers, A. (1996). The Failure and the Promise of Technology in Education.
Global Schoolhouse Network. Retrieved October 5, 1999 from the World Wide Web:
<http://www.gsn.org/teach/articles/promise.html>
- Sadler, P. (1998, November). How Technology Will Change Teaching. Keynote
address at VermontFest '98, Fairlee, Vermont.
- Sandholtz, J.H.; Ringstaff, C. and Dwyer, D.C. (1997). Teaching with technology:
Creating student-centered classrooms. New York: Teachers College Press.

Schacter, J. (1999). The Impact of Education Technology on Student Achievement: What the Most Current Research Has to Say. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 14, 1999 from the World Wide Web: <http://www.milkenexchange.org/projects/research/ME161.pdf>

Schagal, B.; Trahen, W. and Blanton, W. (1996). Structuring Telecommunications to Create Instructional Conversations About Student Teaching. Journal of Teacher Education, 47 (3), 175-189.

Schofield, J. W. (1995). Computers and classroom culture. New York, NY: Cambridge University Press.

Schwann, C. and Spady, W. (1998). Why Change Doesn't Happen and How To Make Sure It Does. Educational Leadership, 55 (7), 45-47.

Seidman, I. (1998). Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences (2nd ed). New York: Teachers College Press.

Sernak, K. and Wolf, C.. (1998). Creating Multicultural Understanding and Community in Preservice Education Classes via Email. Journal of Technology and Teacher Education, 6 (4), 303-309.

Sheehan, K. and M. G. Hoy. (1999). Using Email to Survey Internet Users in the United States: Methodology and Assessment. Journal of Computer Mediated Communication, 4 (3) Retrieved October 4, 1999 from the World Wide Web: <http://www.ascusc.org/jcmc/vol4/issue3/sheehan.html>

Smith, C. (1997). Casting the Net: Surveying an Internet Population. Journal of Computer Mediated Communication, 3 (1) Retrieved November 10, 1999 from the World Wide Web: <http://www.ascusc.org/jcmc/vol3/issue1/smith.html>

Solmon, L. and K. Chirra. (1999). When Enough is Not Enough: Allocating Scarce Resources for School Technology. Santa Monica, CA: Milken Exchange on Education Technology. Retrieved November 10, 1999 from the World Wide Web: http://www.milkenexchange.org/article.taf?_function=detail&Content_uid1=68

Strauss, A. and J. Corbin. (1990). Basics of Qualitative Research: Grounded Theory Procedure and Techniques. Newbury Park, CA: Sage Publication, Inc.

Stoll, C. (1999). High Tech Heretic. New York: Doubleday.

Strot, M. (1998). Individualizing Instruction with Computer Applications. Gifted Child Today Magazine, 21(2), 40-42.

Suppes, P. (1966). The Uses of Computers in Education. Scientific American, 215 (3), 206-220.

Tapscott, D. (1999). The Net Generation and the School. Santa Monica, CA: Milken Family Foundation Retrieved November 22, 1999 from the World Wide Web: http://milkenexchange.org/article.taf?_function=detail&Content_uid1=109

Technology Counts '99. (1999, September 23). Technology Counts '99: Data for Vermont. Bethesda, MD: Editorial Projects in Education. Retrieved November 9, 1999 from the World Wide Web: <http://www.edweek.org/sreports/tc99/updates/states/vt-t.htm>

Thomas, L; Clift, R.; and Sugimota, T.. (1996) Telecommunications, Student Teaching, and Methods of Instruction: An Exploratory Investigation. Journal of Teacher Education, 47 (3), 165-174.

Thornburg, D. (no date). Technology Planning for the Communication Age. San Carlos, CA: The Thornburg Center. Retrieved November 15, 1999 from the World Wide Web: <http://www.tcpd.org/thornburg/handouts.html>

United States Department of Education. (1996) Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge. Washington DC:

United States Department of Education. Retrieved from the World Wide Web:

<http://www.ed.gov/Technology/Plan/NatTechPlan/>

United States Department of Education. (1999). Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers. Washington, DC: United States Department of Education.

United States Department of Energy. (1996). Model Nets: A National Study of Computer Networking in K-12 Education. University of California: United States Department of Energy. November 12, 1999 from the World Wide Web:

http://education.janl.gov/resources/Model_Nets/Introduction.html

Vermont Department of Education. (1996). Vermont's Statewide Education Information Technology Plan. Montpelier, VT: Vermont Department of Education. Retrieved June 3, 1999 from the World Wide Web:

<http://www.vismt.org/programs/infotech/stateplan/state.htm>

Vermont Department of Education. (1996b). Vermont's Statewide Education Information Technology Plan: Guide to Professional Development. Montpelier, VT: Vermont Department of Education. Retrieved November 30, 1998 from the World Wide Web: <http://www.acsu.k12.vt.us/vstc/vtstateplan/PrfDev.html>

Vermont Institute for Science, Math and Technology. (1996). Progress Report. Montpelier, VT: VISMT. Retrieved October 15, 1996 from World Wide Web:

<http://www.vismt.org/programs/infotech/stateplan/progress/status.htm>

Vermont Institute for Science, Math and Technology. (1999). 1999 Vermont School Technology Report. Montpelier, VT: VISMT. Retrieved November 23, 1999 from World Wide Web: <http://www.vismt.org/programs/infotech/research/99techrpt.htm>

Wenglinski, H. (1998). Does it computer? The Relationship Between Educational Technology and Student Achievement in Mathematics. Princeton, NJ: Educational Testing Service. Retrieved November 12, 1999 from World Wide Web: <http://www.ets.org/research/pic/dic/techtoc.html>

Wenglinski, H. (1998b). Summary of Findings. Princeton, NJ: Educational Testing Service. Retrieved November 12, 1999 from World Wide Web: <http://eee.ets.org/research/pic/dic/discumm.html>

Zhao, Y.; S. Rop, R. Banghart, K. Hou, A. Topper. (1998.) Life on the Margins: Stories of Techguides In S. McNeil, J. Price, S.B. Mehall, B. Robin, & J. Willis (Eds.), Society for Information Technology & Teacher Education '98. Association for the Advancement of Computing in Education. Retrieved June 8, 1999 from the World Wide Web: http://www.coe.uh.edu/insite/elec_pub/HTML1998/fd_zhao.htm

A Survey of:
Technology Planning in Southwestern Vermont Schools

Prepared by: [Gary L. Ackerman](#)

Thank you for taking the time to complete this survey of technology planning in your school. The purpose of this study is to understand the methods and organizations that schools in Bennington and Rutland Counties use to develop and implement technology plans. The data will be compiled and analyzed for common and creative methods and procedures. The goal is to better understand technology planning in hopes that the shared knowledge can lead to improved efforts for all.

This work is my thesis for my Master of Arts in Education degree at Castleton State College. My advisor at CSC is [Dr. Diane Wolk](#).

Short excerpts from the data gathered here will be used when the thesis is presented to CSC faculty and during presentations at professional conferences.

Please provide the following information:

Please note: This information is gathered so that I may know who has responded and confirm (if necessary) the responses of participants. No names will be included in any report of this data, and information that could potentially identify participants or their school will be edited from the data.

Your name:
Your school:
Your position in that school:
email address or phone number:

1) Check the boxes to indicate which stake-holders serve on your building technology committee: **(Please answer only for your building committee, do not include district or supervisory union technology committees.)**

check here if your school does not have a building technology committee
 teachers administrators students parents school board members
 community members paraprofessionals technology coordinator
please indicate any other stake-holders on your building technology committee:

2) How frequently does your technology committee meet?

3) Which of these best describes the role of your technology committee?

dialogue to develop understanding recommend decisions make decisions

4) Does your school have a technology coordinator? No Yes, full time Yes, part time

5) Please summarize the responsibilities of your technology coordinator:

6) Does your school have a computer technician? No Yes, full time Yes, part time

7) Please summarize the responsibilities of your computer technician:

8) Please indicate the distribution of computers in your school (check all that apply):

computer room single computers in classrooms mini-labs computers on carts

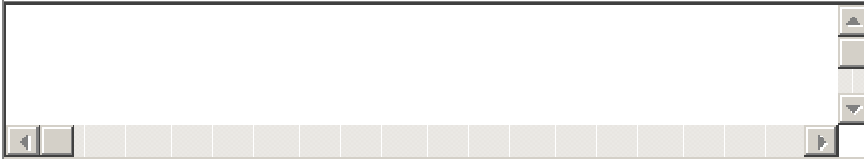
other (please specify):

9) Please describe the typical use of computers by students in your school:

10) Describe what happens when a teacher finds a broken computer in your school:

11) Describe what happens when a teacher in your school wants to increase his or her use of computers:

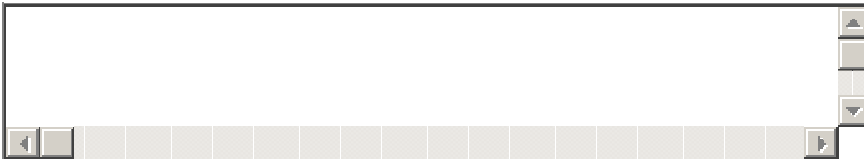
12) What or who has influenced your thinking about computers in schools?

An empty text input field with a light gray border and a scroll bar on the right side.

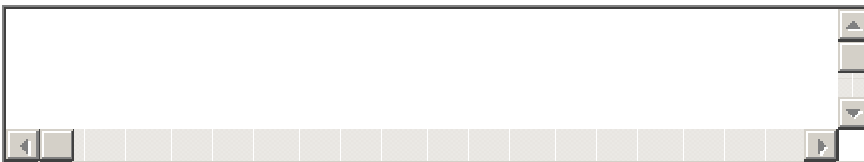
13) How are hardware and software purchase decisions made in your school?

An empty text input field with a light gray border and a scroll bar on the right side.

14) Describe the ways you gather information about technology use in your school:

An empty text input field with a light gray border and a scroll bar on the right side.

15) What are your school's goals related to computer technology for the 199-2000 school year?

An empty text input field with a light gray border and a scroll bar on the right side.

[Reset the entire form](#)

Thank you again for taking the time to complete this survey. When you click the SUBMIT button below, your responses will be emailed to Gary L. Ackerman. Further comments, questions or concerns should be emailed using this link: ackerman@sover.net

A Survey of: Technology Planning in Southwestern Vermont Schools

Prepared by: [Gary L. Ackerman](#)

Thank you for taking the time to complete this survey of technology planning in your school district or supervisory union. The purpose of this study is to understand the methods and organizations used by schools in Bennington and Rutland Counties to develop and implement technology plans. The data will be compiled and analyzed for common and creative methods and procedures. The goal is to better understand technology planning in hopes that shared knowledge can lead to improved efforts for all.

This work is my thesis for my Master of Arts in Education degree at Castleton State College. My advisor at CSC is [Dr. Diane Wolk](#).

Short excerpts from the data gathered here will be used when the thesis is presented to CSC faculty and during presentations at professional conferences.

Please provide the following information:

Please note: This information is gathered so that I may know who has responded and confirm (if necessary) the responses of participants. No names will be included in any report of this data, and information that could potentially identify participants or their employer will be edited from the data.

Your name:
Your district or SU:
Your position in that district or SU:
email address or phone number:

1) Check the boxes to indicate which stake-holders serve on your district or SU technology committee:

(Please answer only for your district or supervisory union committee, do not include building technology committees.)

- check here if your district or SU does not have a technology committee**
 teachers administrators students parents school board members
 community members paraprofessionals technology coordinator

please indicate any other stake-holders on your technology committee:

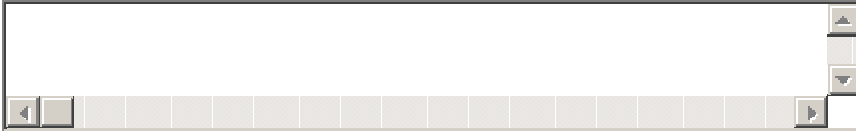
2) How frequently does your district or SU technology committee meet?

3) Which of these best describes the role of your district or SU technology committee?

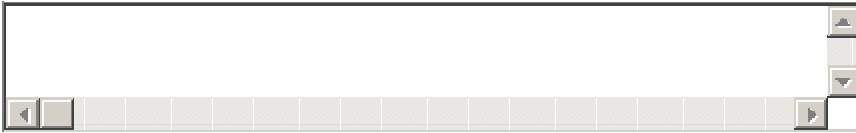
- dialogue to develop understanding recommend decisions make decisions

4) Does your district or SU have a technology coordinator? No Yes, full time Yes, part time

5) Please summarize the responsibilities of your technology coordinator:



6) Does your district or SU have a computer technician? No Yes, full time Yes, part time



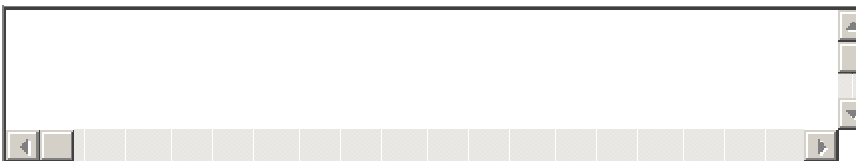
7) What happens when a teacher finds a broken computer in your district or SU?



8) What happens when a teacher in your district or SU wants to increase his or her use of computers?



9) What or who has influenced your thinking about computers in schools?



10) How are hardware and software purchase decisions made in your district or SU?

11) Describe the ways you gather information about technology use in your district or SU:

12) Summarize your district or SU's goals related to technology for the 1999-2000 school year.

Thank you again for taking the time to complete this survey. When you click the SUBMIT button below, your responses will be emailed to Gary L. Ackerman. Further comments, questions or concerns should be emailed using this link: ackerman@sover.net

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Last revised: August 25, 1999

Appendix C: Initial invitation to participate in the study.

Invitation to Participate in a Technology Planning Study

To: Bennington & Rutland County principals
From: Gary L. Ackerman, chair SW VITA-Learn & CSC graduate student
Date: June 8, 1999
Re: technology planning study

This memo is to request your school participate in a study of technology planning and implementation in southwest Vermont. I am conducting this study to provide information for SW VITA-Learn and as the thesis for my MAE degree from Castleton State College.

Participants in this study will answer a brief narrative questionnaire, which should take less than 30 minutes. The questionnaire will be available in two forms: email or diskette.

To participate, please complete the information below and return this to me at the address below or email the information to me.

-- Fill in this space with the name of the person who can best answer questions about how your school develops and implements its technology plan.

What is this person's title? _____

How would this person like to receive the questionnaire?

Email-- provide an email address: _____

Diskette-- Mac disk or PC disk (please circle one)

Address the diskette should be mailed to:

Please reply to:

Gary L. Ackerman
P.O. Box 368
West Rutland, VT 05777

Or: ackerman@sover.net

Appendix D. Cover sheet included with the initial invitations to participate in the study.

VITA-Learn
VERMONT INFORMATION
TECHNOLOGY ASSOCIATION
FOR THE ADVANCEMENT
OF LEARNING

To: Bennington & Rutland County Principals
From: Gary L. Ackerman
Chair, Southwest Vermont Information Technology Association for the
Advancement of Learning
Date: June 8, 1999
Re: Enclosed invitations

Please find enclosed two documents announcing SW VITA-Learn sponsored events for the summer.

- 1) An invitation to attend an administrator's reception at the Cortina Inn on June 29 and a reminder of technology institutes that have been previously announced.

From 4:00 until 5:30, the leadership of SW VITA-Learn will host a reception with fruit and vegetable hors d'oeuvres as part of our Annual Summer Meeting. Please come to hear how SW VITA-Learn can help your school and contribute to our planning process.

- 2) An invitation to participate in a study of technology planning in our region.

This study, which will require only about 30 minutes of your (or your technology coordinator's) summer, will help us understand the many approaches to technology planning and implementation used in the region.

I will gladly answer any questions you have regarding these upcoming events, and I ask that you participate so that SW VITA-Learn can help your school prepare your students for the next century.

The best way to reach me is via email: ackerman@sover.net

Appendix E. Email message sent to a list of leaders in educational technology in early September 1999 requesting participation in this study.

Subject: Request
Date: Wed, 01 Sep 1999 19:10:19 -0400
From: "Gary L. Ackerman" <ackerman@sover.net>
To:

:

As you may know, I am in the process of completing my thesis. I am writing to ask your participation. In a nutshell, I am asking those involved in school technology planning in Bennington & Rutland Counties to tell me about that process. My survey is on the web, and those who have completed it report the process takes less than 20 minutes.

When you have a moment, please follow this link and complete my survey for those involved with technology planning in schools.

<http://www.sover.net/~ackerman/schoolsurvey.htm>

Thanks for your help.

-- Gary L. Ackerman

<< Given the right company, even pyrite in the pan is gold.>>

Appendix F: Second mailed invitation to participate in the study.

Technology Planning Study

To: Education leaders of Southwestern Vermont
From: Gary L. Ackerman
Date: September 20, 1999
Re: Invitation to participate in technology planning survey

I am the chair of SW VITA-Learn, a teacher at the Rutland Middle School, and a graduate student at Castleton State College. Currently, I am gathering data for my thesis. In a nutshell, I am asking those involved with technology planning in Bennington and Rutland Counties to tell me about the process.

I am anxious to include data from as many schools as possible by my deadline of Sept. 24. Please go to the URL listed below and take a few minutes to complete my online survey. (Those who have completed the survey claim the process takes only about 15 minutes.)

<http://www.sover.net/~ackerman/schoolsurvey.htm>

Thanks for your help.

Appendix G: Final email request sent to schools requesting participation.

Subject: Tech Planning Survey
Date: Mon, 20 Sep 1999 19:31:20 -0400
From: "Gary L. Ackerman" <ackerman@sover.net>
To:

:

I am the chair of SW VITA-Learn, a teacher at the Rutland Middle School, and a graduate student at Castleton State College. Currently, I am gathering data for my thesis. In a nutshell, I am asking those involved with technology planning in Bennington and Rutland Counties to tell me about the process.

I am anxious to include data from as many schools as possible by my deadline of Sept. 24. Please follow this link and take a few minutes to complete my online survey. (Those who have completed the survey claim the process takes only about 15 minutes.)

<http://www.sover.net/~ackerman/schoolsurvey.htm>

Thanks for your help.

-- Gary L. Ackerman

<< Given the right company, even pyrite in the pan is gold.>>